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RICHARD P. ROTHWELL, C. E., M. E., Editor.

ROSSITER W. RAYMOND, Ph. D., M. E., Special Contributor.

SOPHIA BRAEUNLICH, Business Manager.

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THIS week's issue of the ENGINEERING AND MINING JOURNAL contains 10 pages of reading matter in addition to the usual 24, and also a two-page illustrated supplement. A large part of our space is given up to condensed abstracts of some of the papers to be read in the Mining and Metallurgical sections of the Engineering Congress at Chicago, which will have begun its sessions by the time this number reaches the majority of our readers. In a later issue we expect to give full reports of the proceedings of the sections in which our readers are specially interested.

NEITHER Colorado, Idaho, nor any other Western State is going out of business, whatever price silver may reach. Their enterprising people will adapt themselves with characteristic energy to the new conditions and will continue to prosper. Fortunes may not be accumulated as quickly, and wages will be lower than formerly, but the Rocky Mountain States will still be profitable fields for the investment of capital.

OUR mining news columns show the extent to which interest in gold producing properties has been excited by the fall in silver. Prospectors are busy everywhere in the search for new gold deposits, and old properties which have been abandoned or only partly worked are being reopened and made ready for further developments. Evidently gold mining, which has been somewhat overshadowed by the magnitude of the silver interest, is to have a new and, we hope, a prosperous growth. This tendency is apparent not only in the West, but in the South, where the extension of mining and the adoption of improved processes for working refractory ores promise to increase the gold output considerably within a few years.

IT is a curious fact that one of the most promising new gold regions of the world is also in all probability the oldest. The gold mines of Mashonaland, in South Africa, for the development of which on an extensive scale preparations are in progress, were worked at so early a period that we can only conjecture the date, and cannot even learn definitely who were the people that have left behind them such evidences of skill in mining, in metallurgy and in engineering. On another page will be found a condensed account of the works of these ancient miners, who must have held the region for a long period, and whose forts and temples have survived for many centuries after the total disappearance of their builders.

THE financial situation far outshadows all trade or technical questions to-day. Every one looks for some measure of revived confidence from the repeal of the Silver Purchase Act, but assuredly that alone will not bring the prosperity expected by some.

The demand for free coinage in the present condition of affairs is pure insanity. There are but two courses open: A scramble for gold, which must enormously appreciate its value and bring a commercial catastrophe or universal bimetallism on a flexible ratio, which will allow of desirable changes being made in the money standards so gradually as not to disturb industry. The wisest course to pursue is that which will quickest bring the nations to an appreciation of the dangers of a sudden change in the world's measure of values.

THE repeal of the Sherman Act seems to be absolutely assured. The free coinage advocates have utterly failed to gain the support of public opinion. Whether the general alarm and loss of confidence in the value of everything, shown in the present terrible financial crisis, are well or ill founded may be an open question, but there can be no doubt whatever that it originated in and is largely sustained by the impression among foreign and home investors that the continued purchase of silver would ultimately drive our gold away, and render it impossible for this country to maintain its silver coinage on a parity with gold.

Since more than 92 per cent. of the business of the country is done on confidence, anything which tends to impair that is of far more consequence than slight changes in the actual quantity of our silver money; it is supreme folly, therefore, to continue the disastrous agitation for free coinage, and thus keep alive the cause of much of the financial distress which is now paralyzing the business of the country. As the wise and patriotic men which they claim to be, let the free coinage advocates frankly and promptly recognize the situation and announce publicly that while still convinced that their policy is the right one, yet in deference to public opinion, and being anxious to promote a return of much needed confidence, they withdraw all opposition to the unconditional repeal of the silver purchase clauses of the Sherman Act.

THE extent of the railroad interest of the country is shown by the appearance of the annual supplement to "Poor's Manual." For a long time the "Manual" gave the only statistics collected which attempted to cover all the railroads of the United States; and although it is now supplemented by the reports of the Interstate Commerce Commission, the delay in publication, which seems inseparable from official Government reports, still permits the "Manual" to give the earliest connected statements of railroad operations. From the introduction it appears that at the close of 1892 there were 175,223 miles of railroad in the country, an increase of 4,429 miles during the year. The gross earnings of these lines

amounted to the great sum of $1,205,272,023, of which over two-thirds, or $846,633,503, was expended in operating the roads, leaving $358,638,520 as net earnings from traffic. In addition to this, the railroad companies received $114.619,545 from other sources (including rentals), making the sum of $473,258,065 in all. Payments for interest and rentals were $334,-524,891, and for dividends on stock $83,336.811. The total amount nominally invested in the railroads was $11,088,933,606, of which $4,920,555,225 is in the form of stock, the balance in funded and floating debts. The average interest paid on all debts was 4·38 per cent., probably the lowest paid on any similar form of obligation, while the average return on the stock was only 1·68 per cent.

In the operation of the roads 35,754 locomotives, 34,221 passenger-train cars and 1,168,867 freight cars were employed. Trains of all classes ran 864,910,463 miles, carrying 575,769,678 passengers 13,697,243,804 miles, and 749,331,860 tons of freight 84,448,197,130 miles. The average passenger traveled 24 miles, while the average haul on a ton of freight was 113 miles. How cheaply the service is done is shown by the average rates, which were last year 2·143 cents per passenger-mile and 0·967 cent per ton-mile. It is curious to note that there are still 38,641 miles of track laid with iron rails; last year 1,115 miles of iron were replaced with steel, and in a few years the iron rail will disappear.

THE EVOLUTION OF THE ANTHRACITE COAL BREAKER.

The hard anthracite coal of Pennsylvania ignites with such difficulty, especially when in large lumps, that when it was first shipped to Philadelphia in 1820 it was thrown away as being nearly incombustible. It was found, however, later, that when broken to a comparatively small size and the fine coal screened out, so as to allow the air to circulate between the ignited lumps, it burned freely and, in fact, that it was the most valuable fuel the world had yet found.

In the early history of the trade this coal was shipped to market as it came from the mine, and the consumer broke it up with hammers, and screened it himself, but the loss in fine coal, which was practically useless since it could not be burned in an ordinary grate nor in any appliance suited to the combustion of coarse coal, was so heavy, and the trouble, annoyance and cost of breaking up the coal by hand so great that some of the merchants were induced to break and screen the coal in the yards, and sell screened coal to the consumer. The popularity of this quickly brought further progress in the same direction, machinery being employed to break and screen the coal, and classify it according to size. This manipulation also afforded opportunity to pick out the pieces of slate which ran through and could not be separated while the coal was in large lumps.

The evolution of the anthracite coal breaker forms an extremely interesting chapter in the history of the Pennsylvania coal trade. Innumerable devices have been experimented with for breaking the coal, commencing with the hammer, passing through various types of dentilated plates and rolls with teeth and corrugations of various forms. A steady progress has heen made in increasing the capacity of breakers and reducing the cost of the work, until now there is probably no other machinery used in the mineral industry in the handling and in the preparation of minerals for market that is so perfect and so economical as that of the modern anthracite breaker. An admirable example of the most advanced practice is illustrated and described on another page. In no other industry do we know of machinery or a single plant that can handle as much as 4,000 tons (of 2,240 lbs.) in ten hours, as can be done in this magnificent plant which the Lehigh & Wilkes-Barre company completed last year at one of its largest collieries.

It is to be noted also that as the machinery has been improved the waste in preparation has been diminished, not only by better and more careful handling, but also by utilizing a larger proportion of the coal. It is not very long ago that what is called "chestnut" was the smallest size of merchantable coal, and even that was sold at a lower price than the larger sizes; while everything below the chestnut size went into the culm pile. Now the chestnut commands the same price as the next or "stove" size, while pea coal, No. 2 pea, buckwheat and rice have been added to the market list, and find extensive use, chiefly in the production of steam. This change has been due directly to the introduction of improved forms of grates and furnaces in which the smaller sizes can be used; and indirectly to the greater competition of these days, enforcing economy both in production and consumption, and making us all realize the necessity of economy.

THE BEST POLICY FOR THE SILVER MEN.

THE free coinage advocates have now an opportunity to do a magnificent service to the cause of bimetallism and to cover themselves with glory.

Let them at once announce that while they still believe their cause just and that its adoption would benefit the world, yet, recognizing that public opinion is overwhelmingly against free coinage or the purchase of silver, and that public confidence, which constitutes the foundation of more than 92 per cent. of the business of the country, has been shaken by fear that the continued purchases of silver will drive out gold and bring us to the single silver standard; and believing that the public announcement of their withdrawal of all opposition to the repeal of the silver purchase act will tend to restore that confidence so urgently needed in business to-day; they are ready as patriotic citizens who seek only the good of the country to join in securing the unconditional repeal of the Sherman Act.

Nevertheless, being fully convinced that the sudden demonetization of silver and adoption of a single gold standard, which is now impending, will not only destroy the value of the money of two-thirds of the human race, but will bring an appreciation in the value of gold which will produce such a world-wide industrial and financial catastrophe as history has never recorded, and believing that this threatened disaster can now be prevented only by international action, they ask that the United States propose to other nations the appointment of an international monetary commission composed of eminent experts empowered and instructed by their several governments—

1st. To select a universal monetary standard.

2d. To adopt measures for securing the use of gold and silver on such a flexible ratio as will afford permanent stability in the value of the world's money.

3d. To adopt measures for facilitating international monetary transactions and for their supervision and control.

The absolute fairness and other intrinsic merits of this plan would meet with universal appreciation, and the patriotic action of the free coinage advocates in surrendering their personal opinions to this arbitrament would bring to them a sympathy and approval which they do not now enjoy. The adoption of this plan would establish the use of silver to an extent not otherwise possible and would benefit not only the producers of the white metal, but the whole industrial world.

If, however, the other nations should not be disposed to join promptly in this Commission, then it is certain that the United States must at once strengthen its gold reserve. Congress should therefore couple the repeal of the Sherman Act with authority and instructions to the Secretary of the Treasury to sell bonds, and purchase and hold not less than $200,000,000 and not more than $500,000,000 of gold, unless, in the mean time, the European nations should join in an international agreement for universal bimetallism on some such plan as that proposed above. We are not alarmists; we are convinced that all that is needed to re-establish confidence and start up the now silent wheels of industry is the positive assurance that this country will at once place its finances in an impregnable condition. No man who is at all familiar with the actual condition below the surface of affairs here will question the necessity of prompt and decisive action in this matter. The repeal of the Sherman Act is essential, but it is not sufficient.

NEW PUBLICATIONS.

HISTORY, THEORY AND TECHNIQUE OF STATISTICS. By Prof. August Meitzen. Translated, with an introduction by Dr. Roland P. Falkner. Philadelphia. The American Academy of Political and Social Science. Pages, 248.

"We understand as statistics an extensive range of practical rather than theoretical problems. They are characterized by the effort to penetrate into the multitudinous phenomena of political and social life, of nature and civilization, by the enumeration of characteristic facts, by classification and explanation."

This opening sentence at once gives Professor Meitzen's definition of statistics, and is the key-note to his whole work. He has undertaken to cover the subject as completely as possible within reasonable limits; to give a complete history of statistical science, and then to show its objects, its methods and the results to be obtained through it. He brought to his work a long experience as a practical statistician which enabled him to study methods and examples, and to show how work of this kind may be well applied, and how it may be worse than wasted. If good statistics are of the greatest value to the student, poor ones are of less than no use, for they are misleading and injurious; and too much of the work done in this direction is thrown away, either on account of the absence of proper judgment and method in those who collect facts, or of knowledge and system in those who arrange and present them.

A little over one-third of the book is occupied by the historical section. Very early in the history of civilization there was a beginning of statistical work. To say nothing of the numbering of the Israelites mentioned in the Bible, there is reliable evidence of the taking of censuses of the people in Egypt, in China and in Persia at an early period, while in Greece and Rome the enumeration of the people and the valuation of property were made with great exactness. All of this ended with the Roman empire, however, and the work was begun over again early in the 16th century by Muenster in Germany, Sansovino and Botero in Italy, and the Sieur de Montmarin in France. Their work was largely disconnected and empirical, and modern statistical science really dates from the work of Gottfried Achenwall, in Germany, 1748 to 1772. From this point the book traces out the history of statistics in different countries, and that of the attempt to secure some uniformity in method and results, which began with the meeting of the first International Statistical Congress, in Brussels, in 1853. Due credit is given everywhere to the work of the eminent statisticians—Sussmilch, Quetelet, Kennedy and others—and to the effect of their labors on the development of the science.

In the second part, on the Theory and Technique of Statistics, Professor Meitzen has developed with great care and in a severely logical way the rules and methods which ought to be applied in statistical work. He has, in full measure, the tendency to generalization and classification, which is a prominent characteristic of the French and German scientific writers, and also a condensed style which at times tends almost to obscurity through the absence of illustration and consideration of special cases. This part of the book requires close and careful reading to enable one to fully comprehend its meaning. Professor Meitzen is so thoroughly master of his subject that he has not always consideration for the student who must follow him at a distance.

The book is, without doubt, the most complete one yet written on the subject, and must be accepted as the standard authority. It ought to be studied by all who have to do with the collection and arrangement of statistics, at least, and perhaps also by many who have to use them. Dr. Falkner has given it a good translation, into clear and readable English.

BOOKS RECEIVED.

In sending books for notice, will publishers, for their own sake and for that of book buyers, give the retail price? These notices do not supersede review in another page of the Journal.

Sewage Purification in America. By M. N. Baker: New York. "Engineering News" Publishing Co. Pages, 196, illustrated.

Report of the Commissioner of Education for the Year 1889-90. *Volumes I. and II.* Washington: Government Printing Office.

Department of the Interior: United States Geological Survey; Bulletins Nos. 82-96. Washington: Government Printing Office.

The Michigan Engineers' Annual, 1893. Kalamazoo, Mich.: Published for the Michigan Engineering Society. Pages, 276; illustrated.

Pleistocene Manganese Deposit near Golconda, Nevada. By R. A. F. Penrose, Jr. Chicago: The University Press. Pamphlet, 8 pages; illustrated.

Twenty Years' Practical Experience of Natural Asphalt and Mineral Bitumens. By W. H. Delano. London and New York: E. & F. N. Spon. Pages, 76; illustrated.

CORRESPONDENCE.

We invite correspondence upon matters of interest to the industries of mining and metallurgy. Communications should invariably be accompanied with the name and address of the writer. Initials only will be published when so requested.
All letters should be addressed to the MANAGING EDITOR.
We do not hold ourselves responsible for the opinions expressed by correspondents

Gold and Silver Mining.

EDITOR ENGINEERING AND MINING JOURNAL:

Sir: Your pointed reply to the "Evening Post's" article on the "Mining of Silver" is a nitting and timely answer to many effusions of that sort, written apparently by those who know nothing whatever about the mining of silver or the working of its ores.

It seems to me that it is about time for the advocates of a single gold standard to pause and explain how an appreciated gold dollar is any more honest than a depreciated silver dollar; also if the existing coinage ratio is unfair, how we are to establish one which will be just, without according the same privileges to silver that gold now enjoys. Why do these people make such an ado about the profits which a few men (very few) realize by being able to mine silver at from 30 cents to 60 cents per ounce, when they are absolutely silent regarding the profits the very same kind of men are realizing, who happen to be unfortunate enough to produce gold at from $5 to $10 an ounce? Is it wrong to make money at silver mining, while it is perfectly right and proper to make the same amount at gold mining, in real estate, in merchandising, in banking, in stocks and the like? No man, as far as I am informed, has ever accumulated as much at silver mining as scores have made in other lines of business. Cannot this question be put before the public so that the average man may see that the same agencies which have decreased the cost of manufactures and products in general have reduced the cost of producing gold to about the same extent? and, therefore, as a general proposition, an ounce of gold should have about the same purchasing power that it enjoyed 20 years ago? Is this metal gold so royal and noble as to be exempt from the laws which govern other products and manufactures?

Now just a word regarding the repeal of the Sherman Act. You advocate the unconditional repeal of the purchasing clause and the issue of a large amount of bonds for the purchase of gold. Those of us who depend upon the silver industry for our living would like to inquire how long it will take, if this plan should be adopted, to accomplish the desired end, and whether there will be any market for silver in the meantime?

A few weeks without an ore market causes us, who are on the ground, to realize, as we have never done before, the consequences to the whole mining and adjacent region of our inability to sell silver ore for a few months only. That means suffering, loss and disaster to a great many people. But the shutting down of our silver mines for a few years, while this policy is being worked out, means vastly more. It means the complete wiping out of the greater part of the capital invested in mines, real estate and business of all kinds. It means several hundred miles of idle railroads and thousands of miles of unprofitable ones. It means thousands of hungry, idle people, seeking employment where they are neither wanted nor needed. It means a great impetus to the growth of socialism and anarchy. It means all this and infinitely more. Is there no other way to work this problem out. Must it be done this way?

GEORGETOWN, Colo., July 17, 1893. C. E. DEWEY.

"The Mineral Industry" for 1892.

EDITOR ENGINEERING AND MINING JOURNAL:

Sir: I have read with great interest the volume on the "Mineral Industry," and have been surprised and gratified at the completeness of the work. A very thorough statement is made of the conditions surrounding all those industries that deal with the useful minerals. The subjects are treated from almost every point of view, sources of supply, markets, processes, prices, statistics, etc., and I think that you are to be congratulated on the results. As a book of reference for the coming year it will be invaluable. The "Mineral Industry" is a fine book.

J. F. KEMP,
NEW YORK, May 5, 1893. Professor School of Mines, Columbia College.

EDITOR ENGINEERING AND MINING JOURNAL:

Sir: It gives me great pleasure to impress my application of the thoroughness and practical utility which characterize the compilation of the "Mineral Industry" throughout. I think you have handled and condensed an immense amount of statistical and other material, in a most masterly manner, and placed it in a form which will be invaluable to engineers, metallurgists and business men, who have not the means or time to obtain much of the material it contains any other way. I can only express a hope that you will issue a similar volume each year, and that it will be of as much service to others as I am sure it will be to me. If it is not on the book-shelf of every one who is interested in mines and mining, it ought to be, and those who are without it will certainly miss an opportunity of enlarging their ideas and knowledge.

A. J. CHARLETON,
ARGELIS, HAUTES PYRENEES, France, May 14, 1893. Mining Engineer.

EDITOR ENGINEERING AND MINING JOURNAL:

Sir: I want to congratulate you on the excellence of the volume and on the splendid system of collecting statistics quickly which is exemplified in your present volume. In this book you have exceeded any publication of the kind either in this country or in Europe, not only in giving us the statistics of our mining industries within a few days of the end of the time to which they relate, but also in having the statistics written up by men who are known to be authorities in the subjects which they treat, thus rendering your readers confident of their correctness. In addition to the statistics, you have given us excellent descriptions of different ore deposits in this country and abroad, as well as of various metallurgical processes and the financial condition of different mining industries. All these features combine to make the book of great value alike to the miner, the geologist, and the business man.

R. A. F. PENROSE, JR.,
PHILADELPHIA, Pa., May 8, 1893. Geologist and Metallurgist.

EDITOR ENGINEERING AND MINING JOURNAL:

Sir: There is nothing to compare with it, and there is no work which gives us bottom facts and figures up to date, in mining and metallurgy, as do the articles in your book. Those of us who for years have depended upon individual efforts for the collection and arrangement of excerpts and references covering our special professional labors can fully appreciate the magnitude of the undertaking and the thoroughness of the work you have accomplished in placing before us this immense amount of detail matter upon so varied subjects and in so short a time. I wish particularly to bear witness to the exceeding value of the articles on copper, gold and silver, chlorination and phosphates, and to offer you more than the common expression of praise for the statistical tables and summaries which answer in so concise a manner about all the questions on economical subjects which have heretofore been widely scattered or beyond our reach.

W. H. ADAMS,
MINERAL CITY, Va., May 12, 1893. V.-P. and Gen. Man. Arminius Copper Co.

EDITOR ENGINEERING AND MINING JOURNAL:

Sir: I cannot sufficiently express my admiration, nay, my astonishment, at the enormous amount of information brought together, not by the resources of a powerful government, but by private enterprise, and that in an incredibly short time, such as has never been attempted from afar by any official organization. The old adage, "Bis dat qui cito dat," will be thoroughly illustrated in this case. You have conferred an addition of very large value to your great work by taking the enormous trouble of translating all the multifarious data into metrical weights, and thus to the greatest possible extent remedying the harm done by that most unpractical "system" still prevailing among the two most practical and pushing nations of the world. I, for my part, am sincerely thankful to yourself and your staff of contributors, for that great work, and I am sure that every one who has occasion to seek information in that quarter will share that feeling.

DR. GEORGE LUNGE,
ZURICH, Switzerland, May 13, 1893.

The Alkaline-Sulphide Process of Producing Nickel.

EDITOR ENGINEERING AND MINING JOURNAL:

Sir: Referring to Mr. Vaughan's letter, in your issue of the 8th inst., and to Mr. R. M. Thompson's article on "The Orford Nickel Process," in the "Mineral Industry," I think your readers may possibly be interested by the following historical notes: In 1839 Mr. Charles Schafhault proposed the reduction of copper sulphides by fusion with alkaline substances. In 1840 Mr. William Jefferies proposed to reduce copper ores by fusion, and the subsequent stirring in of "carbon" and "alkali." In 1842 Thomas Bell proposed to flux copper sulphides with alkaline substances, and to separate the molten mass into upper and

lower portions; he having observed that there was a marked difference in the metallic contents of such "tops" and "bottoms." In 1845 William Gossage patented the separation of copper from other metals by repeating the tops and bottoms treatment until the nickel or other sulphide forming the "bottom" was practically freed from copper.

On May 4th, 1891, an application for a United States patent (subsequently allowed and issued) was filed by an English gentleman, Mr. Charles C. Bartlett, in respect of a "Process of producing and separating sulphide of nickel from ores containing nickel." The specification accompanying this application stated: "I have discovered that when such ores and matters are mixed with ordinary niter cake, as produced from the manufacture of sulphuric acid or with nitrates or carbonates of the alkaline bases, or a mixture of two or more of the same, so as to form a flux, and are smelted as above set forth, a very fluid matte of very light specific gravity will be produced, which will contain practically all of the copper contained in the ore or mattes, while the nickel will remain in the form of sulphides in a mass by itself, and being of greater specific gravity than the rest of the mass will, when the smelted mass is tapped from the furnace, settle to the bottom of any vessel in which the mass is collected. . . . In each case the bottoms, rich in sulphide of nickel, resultant from the first treatment with the flux, are subjected to a further smelting in the same way, and as a result of each settling and separation the impurities will be eliminated from the 'bottoms,' until finally a 'bottom' is produced which consists practically of pure sulphide of nickel. This may be sold as such or may be converted into metallic nickel or into nickel oxide in any convenient manner."

On March 14th, 1892, Mr. R. M. Thompson filed an application for a United States patent (subsequently allowed and issued) for a "Process of obtaining and separating sulphide of nickel." This process consisted "in smelting the ores or mattes containing nickel with caustic alkalies, carbonates of the alkaline metal (sic) or ammonium, or other similar re-agents rich in oxygen, substantially as set forth, whereby the nickel is converted into crude metallic nickel; in allowing the crude nickel to settle and separate by gravity; in separating the crude nickel after settling, and in re-smelting the same with a sulphide of any alkaline metal substantially as set forth, whereby nickel sulphide and caustic alkali are produced, and in allowing the nickel sulphide to settle and separate by gravity, and separating the same after settling."

On March 22d, 1892, an English gentleman, Mr. John L. Thomson, filed an application for a United States patent (subsequently allowed and issued) for a "method of producing and separating sulphide of nickel." This method consisted "in smelting ores or mattes containing nickel with a sulphide of any of the alkaline metals or ammonium, substantially as described, whereby sulphide of nickel is formed which is of greater specific gravity than the remainder of the mass and is precipitated to the bottom of the mass while the copper, iron and salts of soda rise to the top, and may be separated in any convenient manner."

On June 20th, 1892, Mr. R. M. Thompson filed applications for three United States patents (subsequently allowed and issued) for processes of "obtaining and separating sulphide of nickel." The first of these consisted "in smelting ores, mattes, or other bodies containing nickel, with the tops rich in caustic alkalies produced from smelting crude nickel with alkaline sulphides or other re-agents producing sulphides of alkaline metals or ammonium in previous operations." The second consisted "in smelting the ore, mattes, or other bodies containing nickel with a suitable re-agent or flux, substantially as set forth, whereby the nickel is converted into crude metallic nickel, in allowing the crude nickel to settle and separate by gravity, in separating the same after settling, and re-smelting with niter or salt cake substantially as set forth, with an excess of carbon, whereby the niter or salt cake is decomposed and sulphide of soda formed, which unites with the crude nickel to form nickel sulphide, and in allowing the nickel sulphide to settle and separate by specific gravity, and in separating the same after settling." The third consisted "in smelting the ores or mattes containing nickel with suitable re-agents (e. g., carbonates of the various alkaline bases or caustic alkalies) substantially as described, and in allowing the crude nickel so formed to settle, in separating the same after settling in any convenient manner, and in smelting the same in a suitable furnace with tops rich in a sulphide of an alkaline metal or ammonium resultant from the final separations of the sulphide of nickel in previous similar operations, and in allowing the sulphide of nickel so formed to settle, and in separating the same after cooling." I may add that the patents of Mr. C. C. Bartlett and J. L. Thomson have been assigned to the Orford Copper Company.

It will be observed that there are two groups of patents covering substantially the same "alkaline sulphide" method of separating nickel from associated metals. But in 1838 to 1845 copper was the metal of main consequence and nickel was the "impurity" or "bye-product;" whereas in 1891 to 1892 the reverse was the case. This distinction is of great practical importance, even if it have not much legal weight.

YOUNGWOOD, Pa., July 17, 1893. STEPHEN H. EMMENS.

Gold Production of Russia.—The gold product of Russia in 1891 is reported as follows: Oural district, 11,532 kilos.; Tomsk district, 6,891 kilos.; Irkoutsk district, 1,685 kilos. from crown mines and 18,714 from private mines, making a total of 20,399 kilos.; total of all districts, 38,822 kilos. In 1891 the production, as reported in the "Mineral Industry," was 36,310 kilos., showing an increase last year of 2,512 kilos.

The First German Railway.—The road connecting Nuremberg with Furth, the first link in a system now aggregating 26,000 miles in length, was advocated by Messrs. Plattner, Scharrer and Ley, worthy

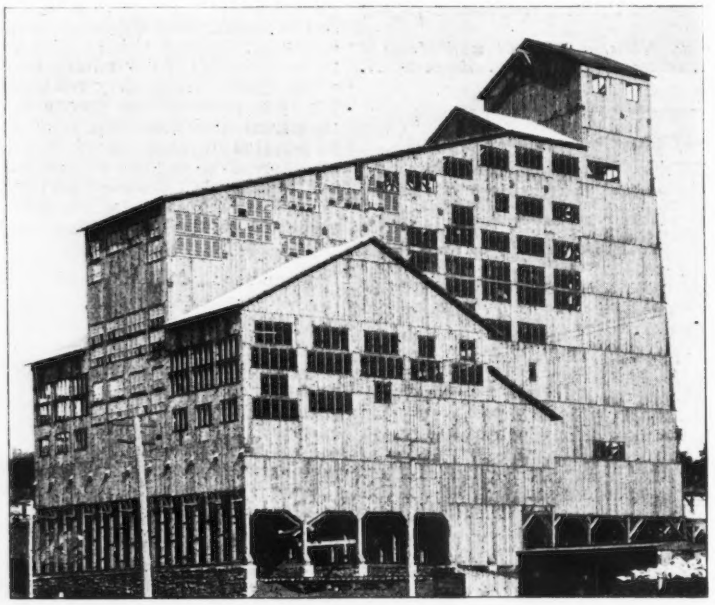


FIG. 1.—NEW BREAKER NO. 5, LEHIGH & WILKES-BARRE COAL COMPANY.

citizens of Nuremberg, who were influenced by the successful working of the English railway between Stockton and Darlington. They were at first met with absurd objections to the scheme by their fellow citizens, and when these were overcome by argument the more difficult task of raising the money was encountered. Though the committee figured a profit of 12% on the investment, it was fully three months before the total capital of 1,320 shares of 100 florins each, or about $56,100 in all, was subscribed. For months all pedestrians, horses and carriages passing between the two towns were carefully counted, and it was figured that the annual expense would be about $5,500, and the yearly income, $12,500; or at least 12% on the capital. But Germany was not yet ready for investment in railways; in 1834 a Bavarian authority attempted to prove that the promoters of the Nuremberg-Furth Railway would annually lose 15% instead of gaining 12%. Robert Stephenson, too, wanted $4,000 a year for sending a mechanic and a translator; and this and the difficulty of obtaining the right of way under existing law made progress so very slow that in 1834 the shares were offered at 30% discount. At this critical time a Bavarian engineer, Mr. Paul Dennis, returned from the United States, and offered his services. They were accepted, and about May 1st, 1835, work was commenced; and the line was opened to travel on December 7th, 1835. The faithful shareholders were rewarded beyond all their expectations, and the shares rose rapidly to 500%. From 1835 to 1860 the line was worked in the forenoon with animal power, and in the afternoon with locomotives, for economy's sake. Until 1847 the yearly number of horse trains exceeded those drawn by locomotives. In 1860 the horses were withdrawn. In 1840 the manager was paid a salary of $500 per year; the traffic inspector received $300, and the cashier $200 per annum. The engineer, however, sent from England by Stephenson received $625 per year, or more than the manager. Although the line now has a competitor in the form of a tram line between the two towns, this first German railway has now a reserve fund of $330,000, and pays 21% dividends on its original share capital, which is still retained.

THE SOUTH WILKES-BARRE COAL BREAKER.

The engravings given with this article show one of the latest and most complete coal "breakers" in the anthracite region of Pennsylvania, Breaker No. 5, of the Lehigh & Wilkes-Barre Coal Company, at the South Wilkes-Barre Colliery. It was completed and put into operation in September last, and has a capacity of 4,000 tons per day. It is a "double" breaker, having two complete sets of machinery, so arranged that either side can be worked independently of the other.

FIG. 2.

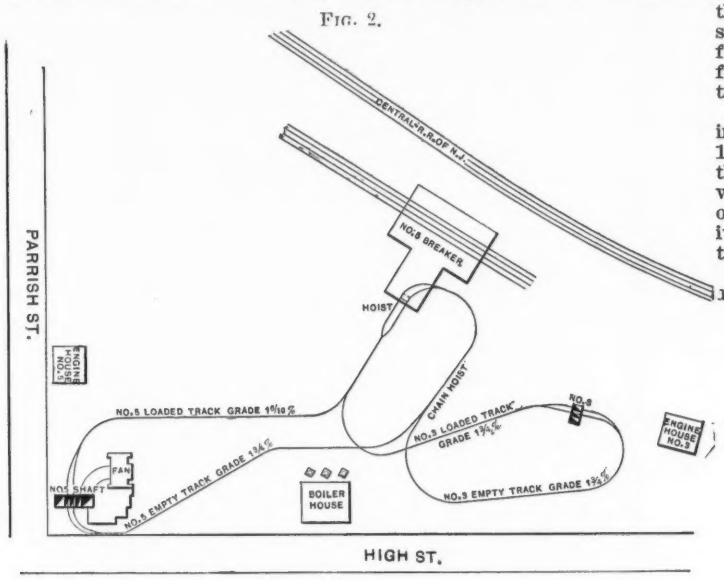


FIG. 4.

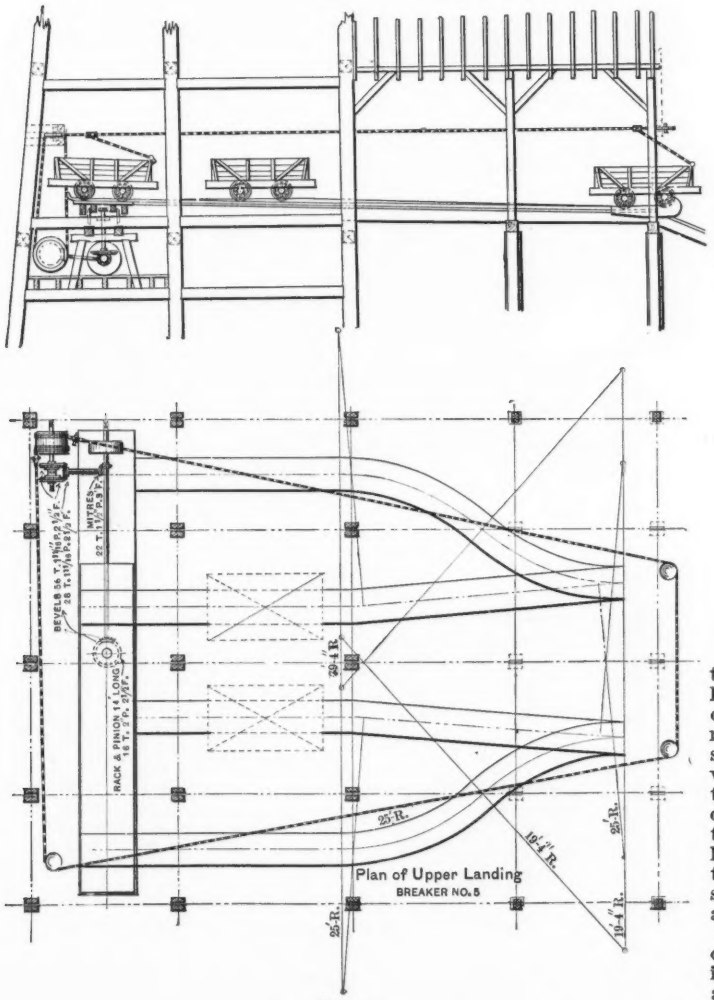


FIG. 3.

The engravings given are from the working drawings courteously furnished us by Mr. Elmer H. Lawall, superintendent of the company, under whose direction this magnificent plant has been erected. The general appearance is shown by the small engraving, Fig. 1, which is from a photograph, and which will give the reader a good idea of the breakers which are seen so frequently in the anthracite country. The coal handled at breaker No. 5 is mined through two shafts, known respectively as No. 3 and No. 5. No. 3 shaft is situated about 210 ft. northeasterly of the breaker, and No. 5 shaft is situated about 500 ft. southwesterly of the breaker. Both shafts are sunk to the Baltimore or "big" vein. The No. 3 shaft is 12 ft. wide by 22 ft. long, and the No. 5 is 12 ft. wide by 52 ft. long. At the present time, coal from the Hillman, an overlying vein, is hoisted through the No. 3 shaft, and coal from the Baltimore vein through the No. 5 shaft. Fig. 2 shows the position of the shafts and the arrangement of the tracks connecting them with the breaker. Fig. 3 is a plan and Fig. 4 is a section of the upper landing of the breaker to which the mine cars are conveyed by the hoist marked on the breaker plan in Fig. 2. Fig. 5 is a diagram showing the course followed by the coal from the time it is dumped from the mine car on the upper landing until it reaches the pockets from which the different sizes are delivered to cars on the railroad track at the foot of the structure.

The mine cars in use at this colliery are 8 ft. 3¾ in. long, 4 ft. 9½ in. wide at the top, and 4 ft. 2 in. at the bottom. The height is 2 ft. 1¾ in. with iron bottom, and 2 ft. 0½ in. with wood bottom. Filled to the level of the top rail an iron-bottomed car contains 79 cu. ft., and a wood-bottomed car 75 cu. ft. As loaded in practice there is an average of 15 cu. ft. of topping, making the capacity 94 and 90 cu. ft. respectively. Most of the cars have wooden bottoms. The average load, taken from a number of cars as they come from the shaft is 6,337 lbs.

The loaded mine cars are run, by gravity, from each mine shaft, to a common track leading to the breaker. On arriving at the foot of

DIAGRAM SHOWING PROCESS OF THE PREPARATION OF ANTHRACITE COAL FOR MARKET.

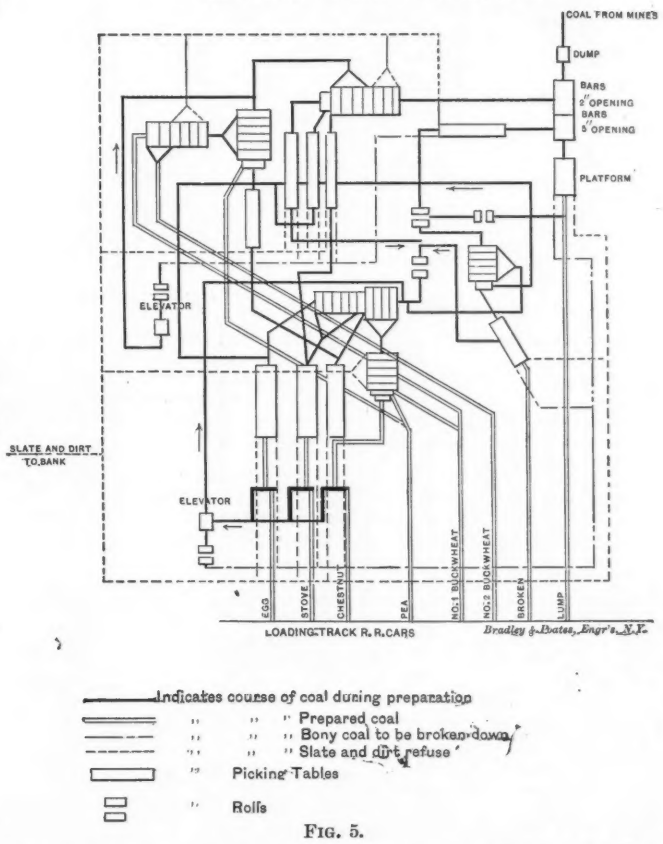


FIG. 5.

this, each loaded car is placed on one of the two hoisting cages, and hoisted to the top of the breaker, then run to the dump chute. After a car has been dumped and emptied, it is carried, by means of a transfer rope and transfer track, around the breaker shaft and allowed to stand immediately back of the shaft on the same side that it was on when loaded, as shown in Figs. 3 and 4. There is a sufficient fall between the transfer track and the breaker shaft to enable the empty car to "bump" off the cage, and take the place of, the next loaded car that comes up on the same side of the shaft. After the empty car leaves the cage at the bottom of the breaker shaft, it runs, by gravity, to the foot of an empty car hoist, whence it is hoisted to an elevation sufficient to carry it back to either the No. 3 or No. 5 mine shaft, to be again lowered into the mines.

To run the machinery in this breaker requires 100 H. P. The number of men and boys required to prepare and load the coal in railroad cars, including the handling of the cars between the shafts and the breaker, and disposing of the refuse, when both sides of the breaker are in operation, is 250. As noted above the average weight of coal carried in the mine cars as they come from the shaft, at South Wilkes-Barre colliery, is 6,337 lbs. The average yield of merchantable coal per car is 4,922 lbs. The refuse loaded in car, and dirt made in preparation, is 1,415 lbs., or 22.3% of the total. The percentage of the several sizes of coal as at present shipped from this colliery, is as follows: Lump, 0·3%; broken, 16·9%; egg, 17·2%; stove, 24·2%; chestnut, 21·0%; pea, 13·7%; buckwheat, 6·7%.

(To be Continued.)

THE ANCIENT GOLD FIELDS OF SOUTH AFRICA.

We are indebted to the interesting pages of Mr. J. Theodore Bent's "Ruined Cities of Mashonaland," for the following description of these little known but promising gold fields and their ancient exploitation.

The development of the gold mining regions of the Transvaal, which has already done so much to increase the white population of South Africa, has been followed by an extension still further northward of settlement and discovery.

FIG: 2.—LARGE CIRCULAR RUIN AT ZIMBABWE.

Until very recently the region lying between the northern boundary of the Transvaal and the Zambesi River was but vaguely known, and had been visited by a few hunters and traders only. Rumors of the existence there of mysterious ruins and evidences of ancient prosperity had been brought back by such visitors; but the journey into the country was difficult and dangerous and no systematic explorations were undertaken.

As long ago as 1871, however, a German traveler, Karl Mauch, entered Mashonaland and discovered some of the ruins of which rumor had spoken. He seems to have gone there with the preconceived purpose of identifying the country with the Ophir of the Bible, and his account

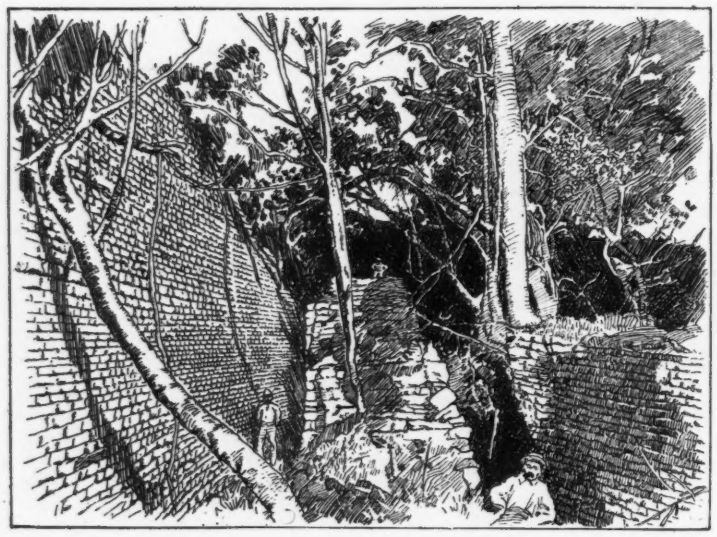


FIG. 1.—TRIPLE WALLS AT ZIMBABWE.

of his discoveries was so warped by this purpose, and contained so many evident discrepancies, that it was not generally credited. Within the past few years the settlement of the Zulu troubles was followed by the annexation of Bechuanaland to the Cape Colony and the formation of the Chartered Company of South Africa, with authority to establish trading posts and settlements in the somewhat loosely defined territories known as Mashonaland and Matabeleland. The former lies between the 17th and 21st parallels of south latitude, and extends from Bechuanaland on the west to the Portuguese coast possessions on the east, including some of the most attractive country in South Africa. It may be generally described as a high plateau, intersected by several mountain ranges of moderate height, generally covered with forests and with many streams and rivers in the valleys, their abundant supply being in sharp contrast to the lack of water which is the great drawback to the prosperity of the Cape Colony.

The establishment by the Chartered Company of posts where an armed force was maintained made the exploration of the country possible, and reasonably safe for a small party; and in 1891 Mr. Theodore Bent undertook the work under the direction of the Chartered Company and the Royal Geographical Society of London, his main object being the examination of the ruins existing there. At that time reports of the existence of gold had already begun to draw miners and prospectors, in spite of the difficulties in the way of reaching the country and of supporting themselves and procuring supplies while there. Mr. Bent's party was small, but well equipped; and he seems to have undertaken the work with a mind free from all theories and anxious only to find the facts, leaving any attempt at explanation until afterward.

To describe the course of his travels and all that he discovered is

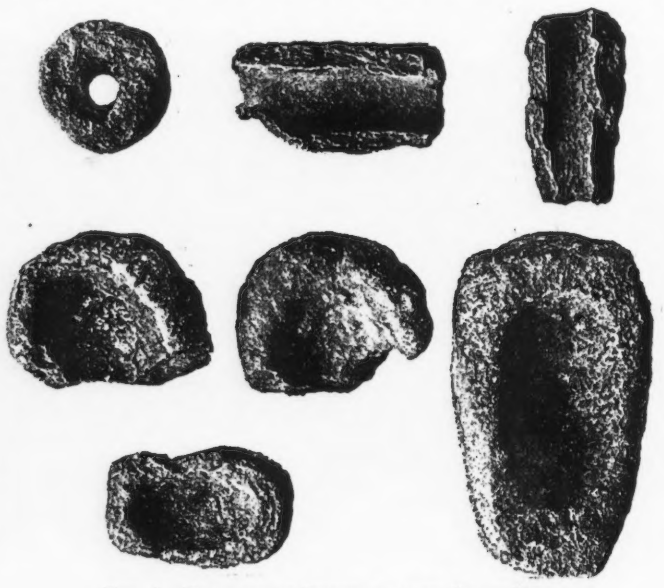


FIG. 4.—REMAINS OF CRUCIBLES AND BLAST-PIPE.

not possible within the limits of an article, and the reader who is sufficiently interested in the subject must be referred to the book itself. The result of his work may be summed up by saying that he has found it reasonably certain that at a very early date the country was occupied by a people considerably advanced in civilization, who established a central fortified city with a chain of outlying military posts, and who held the country not for agricultural or commercial purposes, but primarily and chiefly to work the gold deposits, which they did in a way showing some knowledge of mining and metallurgy.

The ruins of the central post or city Mr. Bent has called "Great

Zimbabwe," a Mashona word meaning "the Chief's Kraal," or capital, as we would say, as distinguished from the various minor capitals scattered over the country. The ruins of this place extend over a space nearly a mile long and a quarter of a mile wide, and are, considering the climate and the lapse of time, in a remarkable state of preservation. While the idea of defense was evidently the leading one in their construction, there are traces of buildings designed for religious purposes, and within the walls of the town are remains of smelting furnaces, depots of stores and other structures connected with the mining industry. The walls of this town are built of small stones worked to a uniform size and laid together without morfar or cement, evidently with great care. That the work was well done is shown by their present condition. The method of construction is shown in Fig 1, which is a view of a portion of the walls taken from the outside, and in Fig. 2, which shows a section of the interior wall of the central citadel or temple. From dimensions, position and arrangement it is believed that the builders of the town must have had some knowledge of mathematics, and that they were in the habit of studying the stars, and probably of worshipping the heavenly bodies, as so many ancient nations did.

The walls have been well preserved, partly because they were laid without mortar, and so closely as to leave no opportunity for vegetation to take root in the crevices, and partly because the present inhabitants of the country do not use stone in building, and have not interfered with the ruins. The remains found in them, so far as Mr. Bent was able to explore them, are of a very interesting character. Those found in the temple and of a religious character indicate that the builders, if not themselves Phoenicians, were of a very similar culture, and practiced a sun or nature worship very similar to that which we know the Phoenicians followed.

Mr. Bent inclines to the belief that this mysterious people who erected these works were of Arab origin. The early people of Southern Arabia were the navigators of the Eastern seas, as the Phoenicians were of the Western; the two nations exchanged commerce and had intimate relations in many ways; and the earliest historic records which we have show that it was from the Arabians that a large part of the gold supply of the ancient world was derived. There is no gold in Arabia itself; the supply must have been brought from another country, and South Africa is certainly the most probable source. Such, in brief, is Mr. Bent's argument, based on the facts he has ascertained.

The relics found at Zimbabwe, which relate directly to mining, include tools (Fig. 3), the uses of which are evident from their forms; remains of smelting furnaces made of cement and clay; crucibles and blast pipes (Fig. 4) of clay; ingot-molds (Fig. 5) which are of the same form as the Phoenician molds for tin ingots found in Cornwall. Fig. 6 shows some fragments of the beveled edge of one of the smelting furnaces. The tools are of bronze, the only iron relic found being the iron bell shown in Fig. 7, which Mr. Bent is inclined to refer to a much later date. In and near the central fort or town there are no indications of mining operations, the ores having, apparently, been brought there from other points to be heated.

The other ruins so far discovered in Mashonaland are much smaller in extent than those of Great Zimbabwe, and seem to have been outlying forts or stations. In every case there have been found near them ancient shafts generally sunk on quartz veins containing gold, so that they were probably built to guard the miners and protect them against hostile attack. Some of these stations are of the same careful construction as the walls of Zimbabwe itself, while others belong to a later age, and are of inferior workmanship; none of them resembles in any way the work of the negro races, who have occupied the country within the historic period.

The date at which the ancient gold workings were begun, and the ancient cities built, must remain uncertain, and purely conjectural; we can only believe that it was far anterior to what we call the historic period. How or when the old miners were driven out of their fortifications is also a matter of conjecture entirely. Most probably it was by one of those great migrations from north to south which seem to have occurred in Africa at intervals from the earliest ages.

The first historic account of the gold of South Africa is given by some of the Arab writers of the 10th century, and somewhat later. They make no mention of permanent settlements or mining operations, and it appears that the Arabs of that period were, like their descendants of the present day, simply traders who procured gold from the natives in exchange for goods. They had no posts away from the coast, and conducted no mining operations. Singularly enough it is recorded that the natives who brought gold to the coast valued it only because they found it useful in trade; for personal ornaments they much preferred brass, and that metal brought a higher price among them than gold. The same fact was noted by the Portuguese explorers of a later date.

The Portuguese navigators, who made their way to the east coast of Africa early in the sixteenth century, found the Arab traders there, and found also that gold was a leading article of traffic. The Portuguese established themselves on the coast, replacing the Arabs as traders, and did not penetrate far into the interior, either as colonists

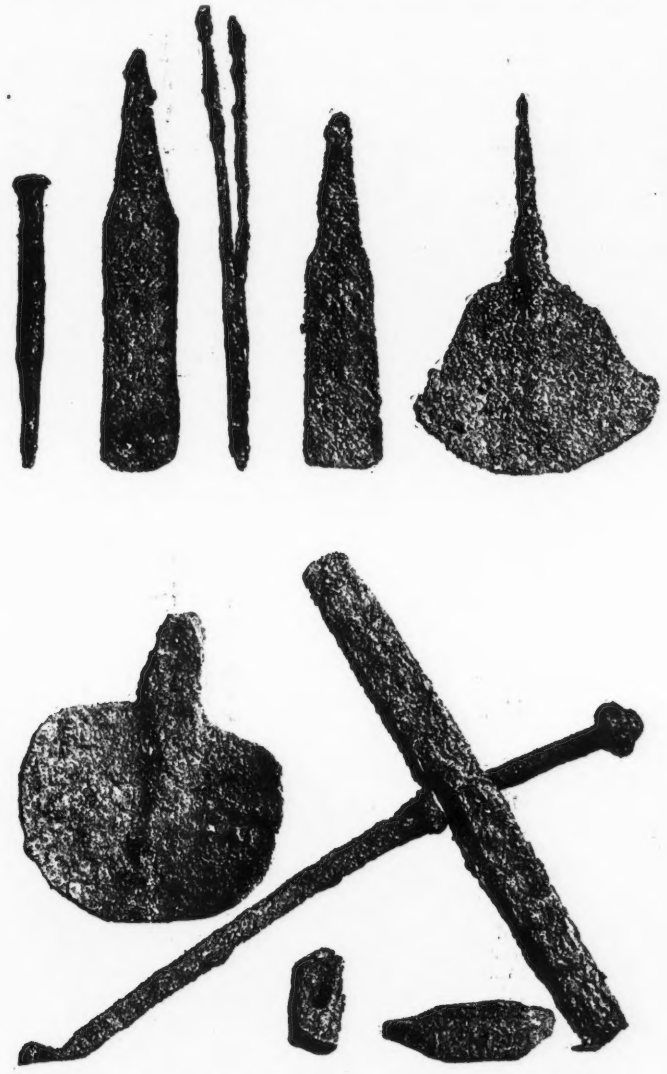


FIG. 3.—MINING TOOLS FROM ZIMBABWE.

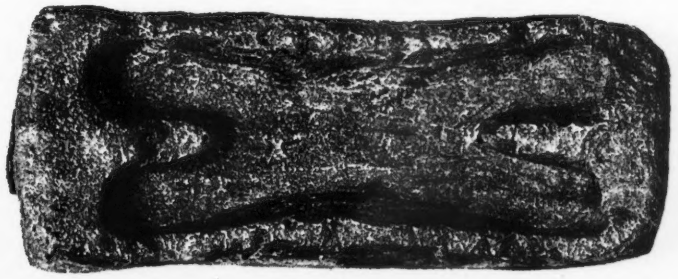


FIG. 5.—INGOT MOULD.

FIG. 7.—IRON BELL FROM ZIMBABWE.

or explorers. The Matapa, or Monomatapa, as the Portuguese called the natives, were expert workers in iron and copper, as their descendants still are, but they do not seem to have followed up the ancient workings or to have had the art of obtaining the metal from the quartz veins, the gold they traded being from alluvial deposits entirely. The Portuguese accounts of the natives and their customs agree fairly well with those of the Arab writers, and some of them also have made mention of the ruined cities; but their accounts were evidently from hearsay, and they never visited the cities nor made any

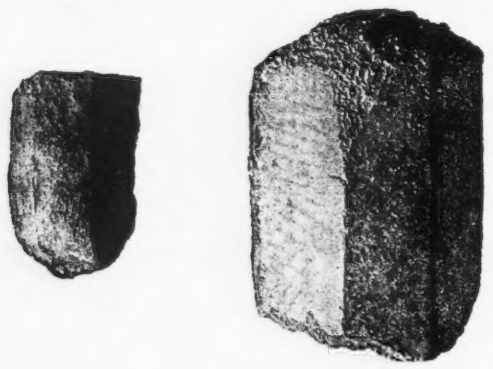


FIG. 6.

extensive explorations back from the coast. Probably about the time of the Portuguese discovery the Monomatapa kingdom began to break up from internal dissensions, and at a somewhat later period was utterly unable to resist the invasion of the Zulus. The people were conquered and scattered, and though they clung to their country they speedily became what they are now, a collection of scattered tribes, with little or no cohesion among themselves and subject at any time to be plundered by Zulu raiding parties.

MASHONALAND METALLURGISTS.

The solitary inheritance this people have retained from their more powerful ancestors is their skill as iron workers, and they have no

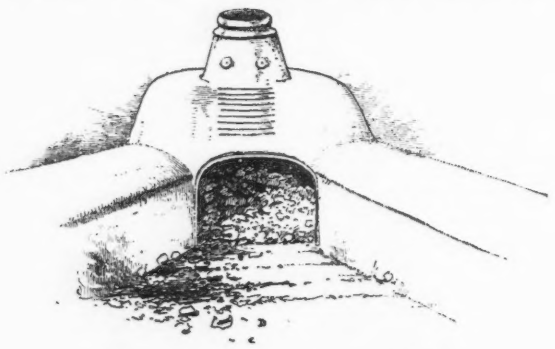


FIG. 8.—MAKALANGA IRON FURNACE.

recourse to the gold mines as sources of wealth. Of their knowledge of iron working Mr. Bent speaks at some length, and gives an interesting description of a furnace for reducing ore as used by the Makalanga tribe, which he visited on his return. The furnace, which is shown in Fig. 8, is built of clay and a kind of cement. The ore is obtained from an open working or quarry on the side of a neighboring mountain, is broken up with hammers and left for a time spread out on the rocks. The fuel used is charcoal, and the blast is supplied by two men, each of whom works two goat-skin bellows, shown in Fig. 9; the blast pipes (Fig. 10) are of clay. It takes the greater part of a day to work a charge; the iron is run out into the ground adjoining the furnace. It is afterward reheated and forged into shape with stone hammers. The ore, it is stated, contains a considerable proportion of manganese.

As to the gold mines of Mashonaland there is no doubt that the ore deposits yielded largely to the depth reached by the ancient miners, and that they extended over a considerable area. How far they do extend, and whether deeper workings will find ore of paying quality or in paying quantities, are questions which can be settled by explortions now in progress.

At present Mashonaland is difficult of access, both for men and supplies. An extension of the present South African railroad system must pass through a broken and difficult country, and the distance from Vryberg, the present northern terminus, is nearly 1,000 miles. The natural route to Mashonaland is from the coast at Sofala or Beira by way of the Pungwe River. Under present conditions this line is available only at certain seasons owing to the fevers of the low coast belt, which are very dangerous to white men, and the prevalence over a considerable part of the route of the dreaded tsetse-fly, which is fatal to draught animals. There are no serious physical obstacles to the building of a railroad, but the Portuguese, who control the coast, have not been willing to build one or to permit the English to build. They have now begun the work, however, and have made some progress. The work of mining in Mashonaland has also been begun in earnest, and this country, which is one of the earliest gold producers in the world, has been once more restored to the list.

THE ENGINEERING CONGRESS

The Congress which will meet in general session in Chicago, July 31st, will comprise the following divisions:

Division A.—Civil Engineering, in charge of the American Society of Civil Engineers.

Division B.—Mechanical Engineering, in charge of the American Institute of Mechanical Engineers.

Division C.—Mining Engineering, in charge of the American Institute of Mining Engineers.

Division D.—Metallurgical Engineering, in charge of the American Institute of Mining Engineers.

Division E.—Engineering Education, in charge of a special committee, Prof. I. O. Baker, University of Illinois, Champaign, Ill., Chairman.

Division F.—Military Engineering, in charge of Maj. Clifton Comly, Governor's Island, N. Y

Division G.—Marine and Naval Engineering, in charge of Commodore George W. Melville, U. S. N., Washington, D. C.

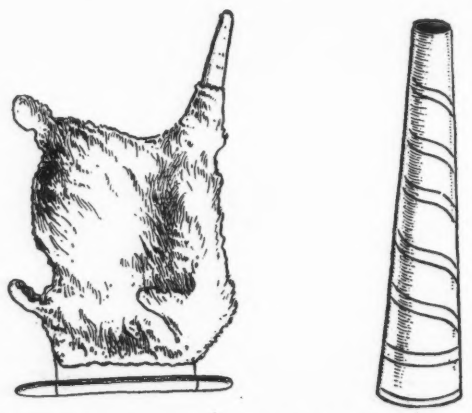
In Divisions C and D, of which the American Institute of Mining Engineers has charge, many interesting papers will be read. We give below abstracts of a number of the more important, and will give full reports of the meeting next week.

IMPROVED SLAG-POTS; BY H. A. KELLER, BUTTE. MONT.

This paper describes the form of slag-cart or buggy, usually called slag-pot used at the Parrott Works, at Butte, Montana, comparing them with the older forms, and also with those used in the smelting works at Pueblo, Colo., which are described in Hofman's "Metallurgy of Lead." These slag-pots are carefully and minutely described, and their work given.

MINING AND MINERAL STATISTICS; BY C. LE NEVE FOSTER, D. SC., F. R. S., LLANDUDNO, NORTH WALES.

The object of this paper is to offer a few suggestions for improving the mining and mineral statistics presented by the governments of various nations on both sides of the Atlantic. At the present time one may fairly complain of two evils—lack of uniformity in some cases and want of completeness in others. The consequence is that the statistics are either less plain than they might be, or are useless for comparisons, or fail to present a faithful picture of the state of the mining industries of a country.



FIGS. 9 AND 10.—BELLOWS AND CLAY BLAST-PIPE.

1. Quantity of mineral raised; 2. Value of the minerals; 3. Number of persons employed in producing the minerals; 4. Number of fatal accidents among these persons; 5. Death rates from accidents; 6. Duration of life of the persons employed in and about mines.

Mr. Foster calls attention to the many differences in method of making out government statistics, and strongly urges uniformity, or that the different governments shall at least add to their several reports one general complete table based on a uniform method of weights, measures, and classification. He further adds that such tables might be collected by some central body such as the American Institute of Mining Engineers, in the form of a small pamphlet, to be known as the Mineral Statistics of the World.

BLOWING ENGINES; BY JULIAN KENNEDY, PITTSBURG.

In this paper the author describes and compares several well known types of blowing engines, including, first, the vertical engine with air cylinders above, crossnead between the steam and air cylinders, and two flywheels, a very common arrangement; second, the horizontal engine of the same general type; third, the vertical double engine with air cylinders above, steam cylinders below, crank shaft and flywheels at the bottom; fourth, the horizontal engine of the same type. The double engine gives a very uniform pressure of blast and presents many advantages. It can readily be compounded and is generally a compact and convenient type of engine. The weak point about many blowing engines is the air valves, which are frequently so constructed as to cause unnecessary friction, and have too small inlet openings. As a type of the latest practice this paper describes a compound engine of the Corliss type, built recently by the E. P. Allis Company, of Milwaukee, for the Ohio Steel Company. In conclusion, he believes that the tendency in designing blowing engines seems to be in the following directions: 1st, compounding; 2d, obtaining valve-gear which will give liberal openings at both inlet and outlet, and which can be operated at a fairly rapid speed. The latter advantage can probably be best secured by the use of metal valves operated as far as possible posi-

tively, which will also do away with the vexation due to the use of leather, gum, and other short-lived materials.

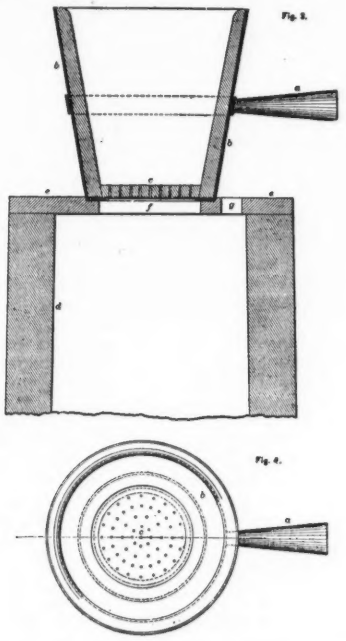
EXPERIMENTS ON THE SPECIFIC GRAVITY OF GOLD IN GOLD-SILVER ALLOYS; BY HENRY LOUIS, SINGAPORE.

Four alloys of gold and silver were prepared, containing the metals in the following proportions by weight: 1. Gold : Silver : : 1 : 2·62; 2. Gold : Silver : : 1 : 3·15; 3. Gold : Silver : : 1: 4·11; 4. Gold : Silver : : 1 : 5·17.

These alloys were rolled, with repeated annealing, into thin strips, rather thinner than is usual for assay cornets. The strips were thoroughly annealed, cut into pieces and dropped into hot parting acid. They were boiled twice with No. 1 parting-acid for one hour and ten minutes altogether, and then with No. 2 parting-acid for 30 minutes, washed thoroughly with boiling distilled water, and left under water under the exhausted receiver of an air pump for 30 hours.

Their specific gravities were then taken at 15° C. with the following results: No. 1. Sp. Gr., 20·36; No. 2. Sp. Gr., 20·20; No. 3. Sp. Gr., 20·31; No. 4. Sp. Gr., 21·8.

Rejecting No. 4 as being probably due to an error, it is safe to take the specific gravity of the gold residue left on dissolving the silver-gold alloys at about 20·3 at 15° C. Apparently, the varying proportions of the two metals in the alloys do not affect the result.



Gold thus left, on dissolving out the silver, is highly spongy, and, on annealing, it undergoes a very evident shrinkage. The result now obtained proves that, on annealing, the molecule of gold does not contract, but, on the contrary, expands, the shortage of bulk being due to a diminution of the physical interspaces between the particles of gold, while the interatomic distances must increase, the diminution being, of course, greatly in excess of the increase.

With regard to the figures here given, it may be noted that Rose obtained, for the specific gravity of precipitated gold, results varying between 19·49 and 20·72. His figures, taken together with mine, seem to point clearly to the existence of a heavy allotropic modification of gold. It is, of course, possible, that the brown amorphous gold obtained, either by precipitation or by the removal of the silver from a silver-gold alloy, may be a mixture of ordinary and allotropic heavy gold, in varying proportions; there can, however, be little doubt of the allotropism and of the further fact that gold exists in the alloy in this allotropic form.

TESTS OF HYDRAULIC MATERIALS; BY H. LE CHATELIER, PARIS, FRANCE.

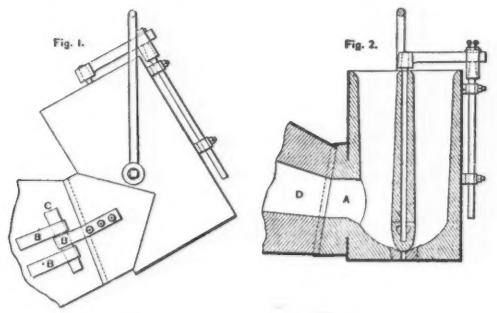
In this paper the author calls attention to the fine laboratories established at Paris, Zurich, Charlottenburg and St. Petersburg, and the numerous conferences and congresses that have been held for the purpose of studying methods and results of the testing of hydraulic cements. It is his opinion that while good service has been rendered by these, the growing multiplicity and complexity of the tests proposed necessarily leads to their restricted use, and he according seeks to separate those which are good and necessary from those which are unessential. In discussing the matter he lays it down that the choice of methods must be preceded by preliminary studies of the three following factors: (1) The exterior qualities which co-operate in the deterioration of hydraulic qualities of cement (rain, drying, sea-water, etc.); (2) the intrinsic properties which render them more or less able to resist such causes (chemical composition, degree of calcination, fineness of grinding, etc.); finally (3) the conditions of application which play a part in the more or less rapid alteration of the products (the water of tempering, sand, compactness, etc.).

Following this he treats of the chemical composition of hydraulic products, including therein the general laws of solution, the hardening of hydraulic materials, swelling by slacking, and chemical compounds in cements. Cements are then classified as follows: Portland cements, hydraulic limes, natural cements and mixed cements. The agents of disintegration are then considered, and thus the way is prepared for a discussion of the methods of testing. Chemical, physical and mechanical tests are exhaustively considered, full details of manipulation being given. M. Le Chatelier's conclusions are that in the present state of knowledge and practice, the following tests are to be recommended: 1. Fineness of grinding—according to the residue from a sieve of 900 meshes per square centimeter (5,850 per squar inch); 2. Resistance to crushing—determined upon blocks of mortar composed of one part of cement to two of sand, tempered to plasticity; the sand having a uniform grain of about 1 mm. (0·04 in.) diameter, and the blocks being cubes of 70 mm. (2·8 in.) or cylinders 2·5 mm. (1 in.) in height and diameter; 3. Invariability of volume in boiling water; 4. Rapidity of setting—the mortar being composed of one cement to two sand, and tempered to normal consistency; 5. A fifth test, for the detection of aluminates, should be the object of investigations conducted in the hope of becoming able to foretell the stability of cements in air or sea-water.

THE BESSEMER PROCESS IN SWEDEN; BY PROF. RICHARD AKERMANN, STOCKHOLM.

The Swedish Bessemer steel-makers have the advantage of iron comparatively free from phosphorus and sulphur, while in many cases it is not necessary to add manganese in the converter, as the iron carries a sufficient proportion. The plan of taking iron direct from the blast furnace to the converter is generally followed, and, in fact, originated in Sweden. The paper gives a number of analyses of pig iron and of blast furnace slags from different Swedish furnaces.

A consequence of the low percentage of silicon in the pig-iron is that the boil, or violent ebulliton of the carbon, generally begins from ½ to 3 minutes after the blow has begun, and the ordinary time for the entire blow is not more than 7 to 10 minutes, not counting the time used in taking samples. The area of the tuyere-holes, which in Sweden are very large as compared with the charge of pig-iron, contributes in large measure to this result. This area generally amounts to from 30 to 35 square centimeters per ton of pig-iron; exceptionally, it may on the one hand reach 50 and on the other hand 15 square centimeters per ton. That the proportion just now mentioned is so large depends, however, by no means on an absolutely large total tuyere-area, but simply upon the small charges, which in general do not amount to more than 3,000 to 3,500 kilograms of pig-iron. The converters are proportionately small, their diameters being about 1·5 to



CASPERSSON'S CONVERTER LADLE AND STRAINER TUNNEL.

1·6 meters, but at the bottom only 1·2 to 1·3 meters, while the interior height from the bottom to the mouth usually varies between 2 and 2·5 meters (6·56 and 8·2 ft.).

For more than 20 years, rotating converters exclusively have been used in Sweden, and for the better preservation of heat they always have the mouth on the side. For the same reason the mouth of the converter is always very narrow, being often only 0·2 to 0·25 meter, but occasionally 0·3 meter in diameter. The total area of the tuyeres amounts generally to 80 or 120 square centimeters, and is most often divided up into from 70 to 200 holes, for the most part 9 to 10 millimeters, but now and then 6 to 15 millimeters in diameter. The pressure of the air is most frequently between 400 and 1,000 millimeters of quicksilver (equal to 7·8 and 19·6 lbs. per square inch) and the blowing engines are generally of from 600 to 900 H. P.

To avoid loss by the formation of ladle skulls is the object of Caspersson's converter ladle, which has, since 1880, been used with greatest success at the majority of the Swedish Bessemer works. This arrangement, illustrated in Figs. 1 and 2, consists of a narrow ladle, which is furnished low down on the side with a lateral opening, A, that fits the mouth of the converter, D. Immediately after the blow, the ladle is brought up to the converter-mouth and made fast by means of wedges, C, in the lugs, B (see Fig. 1). The converter is then turned down still farther, so that its position is as indicated in Fig. 2, and a part of the bath of metal runs into the converter-ladle, while most of the metal remains in the converter. It is precisely on this circumstance, coupled with the smaller depth of bath occasioned thereby, that the advantages of the converter-ladle depend. A ladle, being never as hot as a converter at the end of a blow, operates, therefore, always to chill; but as the converter-ladle is quite small, its power to chill the metal bath, the incomparably larger part of which remains in the converter, after it has been turned down, is far less than that of an ordinary ladle, which receives all of the molten mass. The result is that the liquid Bessemer metal can be allowed to remain in peace and quiet longer, to permit the gases to escape, and without fear of partial freezing before being tapped into the molds, than before the advent of the converter-ladle; at least, longer than was possible with a product only as moderately hot as the Swedish Bessemer metal generally is, especially since the quantity handled in Sweden at each blow, as has been shown, is comparatively very small, and consequently the cooling effect of the ladle is proportionally great. By the aid of the converter-ladle, ladle-skulls, formerly so common here, can be pre-

vented. But to this great advantage may be added another, viz., that the product is somewhat freer from blow-holes, partly because with the converter-ladle a longer time is given for the escape of the gases and for the more complete separation of the slag by rising to the surface, and partly on account of the more moderate speed of the stream of metal incident to the smaller depth of bath. Since the converter-ladle, during teeming, is fast and immovably fixed to the converter, it is evident that the former cannot, like an ordinary crane-ladle, be carried over the molds, but that the molds must be brought under the converter, either on cars or on a turntable. To prevent the formation of bad and faulty ingots Mr. Caspersson has complemented his converter-ladle with a so-called strainer-funnel, illustrated in Figs. 3 and 4. The plate-iron funnel, b, furnished with the handle, a, and lined with refractory material, has the easily withdrawable chamotte-bottom, c, which is provided with many larger or smaller holes, the number of which is larger in the same degree as their diameter is smaller. When teeming takes place, there is first laid upon the mold, d, a cast iron disc, e, with an opening in the middle, f, corresponding in size to the changeable funnel-bottom, and a little side hole, g, which affords a chance for the gases separated during teeming to escape, and also for the man who directs the tapping to judge when the molds have been suitably filled. The pre-heated funnel is placed over the central opening, f, and the metal, tapped out through the converter-ladle into the strainer-funnel, is divided by means of the holes in the bottom into more or less numerous streams of smaller or larger size. This division of the metal ocasions, during its passage down into the mold, both a more complete removal of gases and greater cooling than takes place in the ordinary mode of tapping. The finer the strainer-holes the more effective does its work become. There should be, therefore, at least two different kinds of strainer-bottoms at hand, one with larger and the other with smaller holes, and the choice between them can be made according to the temperature of the blow. After an unusually hot blow a bottom with smaller holes is taken; and if the temperature during the blow has been just hot enough, no strainer at all is used. It might be supposed that the division of the metal into many fine streams would be likely to be dangerous by reason of the risk of partial oxidation with accompanying red-shortness; but experience shows that this is prevented by the gases which escape from the metal and speedily fill up the mold covered by cap, e, thus hindering the contact of the streams with the air.

MICROSCOPIC METALLOGRAPHY, BY F. OSMOND, PARIS, FRANCE.

When a metal (whether a simple substance, an alloy, or a compound) presents, in each of the smallest parts to which it can be reduced by mechanical division, a constant chemical composition, it is defined as chemically homogeneous. But chemical homogeneity by no means necessitates mechanical homogeneity. There are no perfectly amorphous metals. Crystalline forces, on the one hand, and tensions or compressions, on the other hand, determined by inequalities of temperature in the mass during heating or cooling, give rise in every metal to the formation of geometric elements of structure. These elements may, moreover, assume perfect crystalline forms, with their planes of cleavage; or embryonic crystalline forms, segregated in the midst of a paste of confused organization; or pseudo-crystalline forms of expansion and contraction, like those produced in the drying of gelatinous precipitates or (most frequently) these different forms associated. In either case the adhesions between two adjoining structural elements, respectively homogeneous, may be very different from the interior cohesion of each of these elements. The mechanical properties of this complex aggregate cannot be simple,, and, when it is submitted to strains sufficient to produce deformation, the results may be very different according to the type of structure or the manner in which it is affected by the strains. It may be fairly said that a metal does not present a single resistance to tension, or a single resistance to compression, etc., but, in fact, at least theoretically, as many resistances to tension, compression, etc., as it may possess coexistent features of structure; only, in any single test, it is the weakest of the resistances involved which makes itself evident.

As the study of rocks has given birth to the special science of petrography, the exact knowledge of metals calls for a corresponding science, which may be named "Metallography." This originated with the work of Dr. Sorby, in 1864, and of Professor Martens, in 1878, and has been carried on by Wedding, Barba, Dudley and others since.

The first step in studying metallic structure under the microscope is polishing. It is difficult to formulate absolute rules; for the arrangement of the polishers (if mechanical means are employed), the choice of polishing substances and of the substances used as supports may be varied according to convenience within wide limits. Dr. Sorby employs at the beginning emery papers mounted upon plate-glass, using consecutively finer and finer grades, down to the finest furnished in commerce. He continues the work with fine-grained water-of-Ayr stone; then with the finest crocus; and ends with the best washed rouge, with which he sprinkles a wet cloth held upon a perfectly plane wooden backing. When the final emery paper is of good quality, the use of the rouge may follow immediately without any intervening step. Professor Martens substitutes for emery the stone called "Oelstein," largely employed by Swiss watchmakers, the powder of which he washes with the greatest care, so as to separate it into different classes of fineness, each of which shall be perfectly uniform.

Various forms of microscopes and of photographic apparatus can be used, and several are described in the paper. The methods used to prepare the sections are coloration by heat and attack by chemical re-agents. The first and most important of the metallic tests mentioned in this paper are those showing the constituents of steel.

In the carbon-steels three constituents are unanimously recognized. These are described by Dr. Sorby as (1) free iron; (2) the nacreous or pearly constituent; (3) iron combined with carbon. On the other hand, Professor Wedding distinguishes: (1) crystalline iron; (2) homogeneous iron, softer, and (3) homogenous iron, harder, than the crystalline. Finally, Mr. H. M. Howe, who in his admirable "Metallurgy of Steel," has devoted to metallography some excellent pages, proposes to give to these three constituents the names Ferrite, Pearlyte and Cementite. The use of this triple nomenclature may easily have created certain confusion in the minds of readers, leading them to suppose that the constituents recognized by Professor Wedding were not the same as those of Dr. Sorby. But this is not the case. An attentive study of the original memoirs, aided by practical experience of the matter in question, justifies the assertion of the identity of the things under the diversity of the names. The names of Professor Wedding have the disadvantage of giving for each constituent a definition which, as we shall see later, is open to controversy. On the other hand, the names proposed by Mr. Howe seem felicitous; they are brief; they do not prejudge (as it would be premature to do) the nature of the several constituents; and, by their mineralogical terminations, they establish a just relation between metallography and petrography. For these reasons they have been adopted in this paper.

A number of photographic plates made by Mr. Osmond are given in the inset plate accompanying this number. They show the results obtained by examining steel bars and the explanations accompanying the plates. They include sections of soft steel (0·14% carbon); medium steel (0·45% carbon); hard steel (1·24% carbon); and blister steel. By these examinations much information has been secured as to the effects on steel of hammering and rolling, of heating annealing and hardening. Much has been done also in the study of accidental defects, such as blow holes, bores, etc., and in recognizing the unequal distribution of foreign bodies in a mass of steel. While much remains to be done, and certain questions have been as yet hardly attacked, two facts seem to have been ascertained: 1. When different steels are compared in the same state their microstructure is, to a certain extent, characteristic of their hardness. 2. When samples of the same steel are compared in different states the microstructure is an indication of the manipulations which the steel has undergone, of the temperature from which it has been cooled, and of the rate of cooling.

In this way micrography complements analysis, and shows whether ties of steels and the varied aspects of their structure. In the meanods, and whether it will endure the strains to which it is to be subjected. In the present state of our knowledge, such deductions can be nothing more than personal estimates, lacking precision and certitude. Micrography cannot replace the old methods of testing, until it shall have established numerical relations between the mechanical properties of steel, and the varied aspects of their structure. In the meantime, it can only qualify, somewhat vaguely, the metal examined, as good, passable, mediocre or bad. But it has an immediate value, nevertheless, in that it throws more light than is derived from tensile tests, upon the causes of the actual condition of a steel. It enables us to reconstruct the thermal treatment to which the steel has been subject, and to modify this treatment if practicable. In this way, Mr. Dudley has been able to draw from his microscopic observations conclusions both just and useful concerning the manufacture of rails.

It may be fairly said, that a steel derives all its mechanical properties from its chemical composition, its molecular condition, and its structure. This statement is not exactly novel; it was put forth about 1878 by the engineers of the Terre Noire works, who, in their turn, had predecessors holding the same view. Yet the proposition has remained in dispute, and has received but scanty recognition. Thus it has been sought to determine the relations between the variables; for instance, between the chemical composition and the wear of rails; or, even between the amount of rolling and the resistance to shock; relations which unquestionably exist, but which are most frequently masked in industrial products by irregularities of structure. Now that the essential influence of structure has been made plain for all time to come, we may hope that this new independent variable will be introduced into such investigations, or eliminated beforehand, so that, to the greatest benefit of both producers and consumers, the relations may be ascertained which connect the qualities of steel with their chemical, physical, and mechanical coefficients, as determined by the tests of manufacturers and inspectors.

While microscopic studies have thus far been confined chiefly to steel, some interesting studies have been made of wrought-iron, cast-iron, and the alloys of copper. In the latter Mr. Guillemin found it possible to determine by the microscope the nature of the alloys, and, for a known alloy, the conditions of casting and the mechanical work performed. These studies are capable of great extension.

IRON ALLOYS, WITH SPECIAL REFERENCE TO MANGANESE STEEL.*

By R. A. Hadfield, Sheffield, England.†

I.—IRON.

Professor Arnold, of the Sheffield Technical School, who has done so much excellent work in metallurgical research, recently produced, with the aid of aluminum, a sound ingot and bar from the purest known Swedish brand containing 99.8% of pure iron. Table I. shows the physical quantities of this metal.

The tenacity of pure iron (though so far commercially no absolutely carbonless iron has yet been obtained, Professor Arnold's sample containing ·07 per cent. C.) is about 18 to 21 tons per square inch; but by admixture of various elements, and by judicious hardening and tempering, or treatment of similar nature, this property can be increased in forged bars up to 110 tons, or in wire to over 200 tons per square inch. Its yield or permanent set may be as low as 6 or 8 tons per

* A paper presented at the Chicago meeting of the American Institute of Mining Engineers in Division D of the International Engineering Congress.

† NOTE BY THE SECRETARY.—The manuscript of this paper having been received too late to be printed in advance by the Institute, the "Engineering and Mining Journal" kindly undertook to put it in type for use at the meeting. The present is therefore the official edition, subject to revision by the author.—R. W. RAYMOND, Secretary.

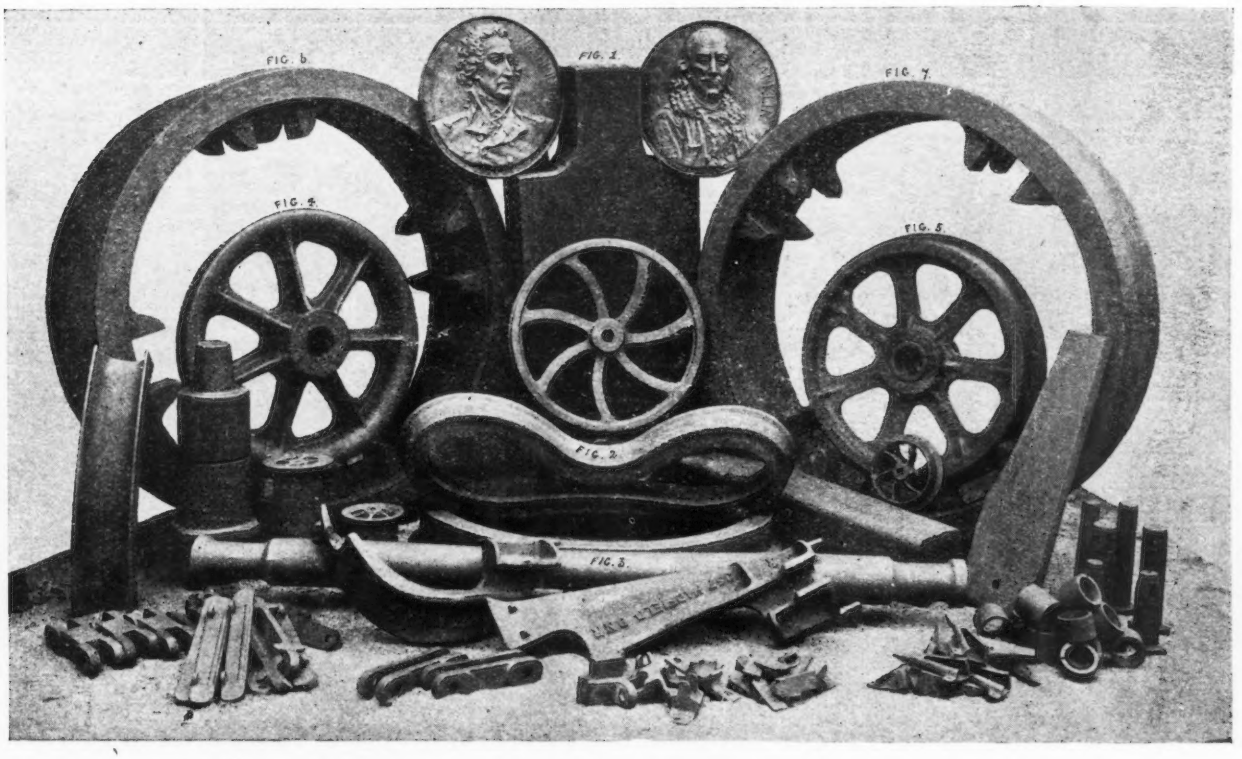
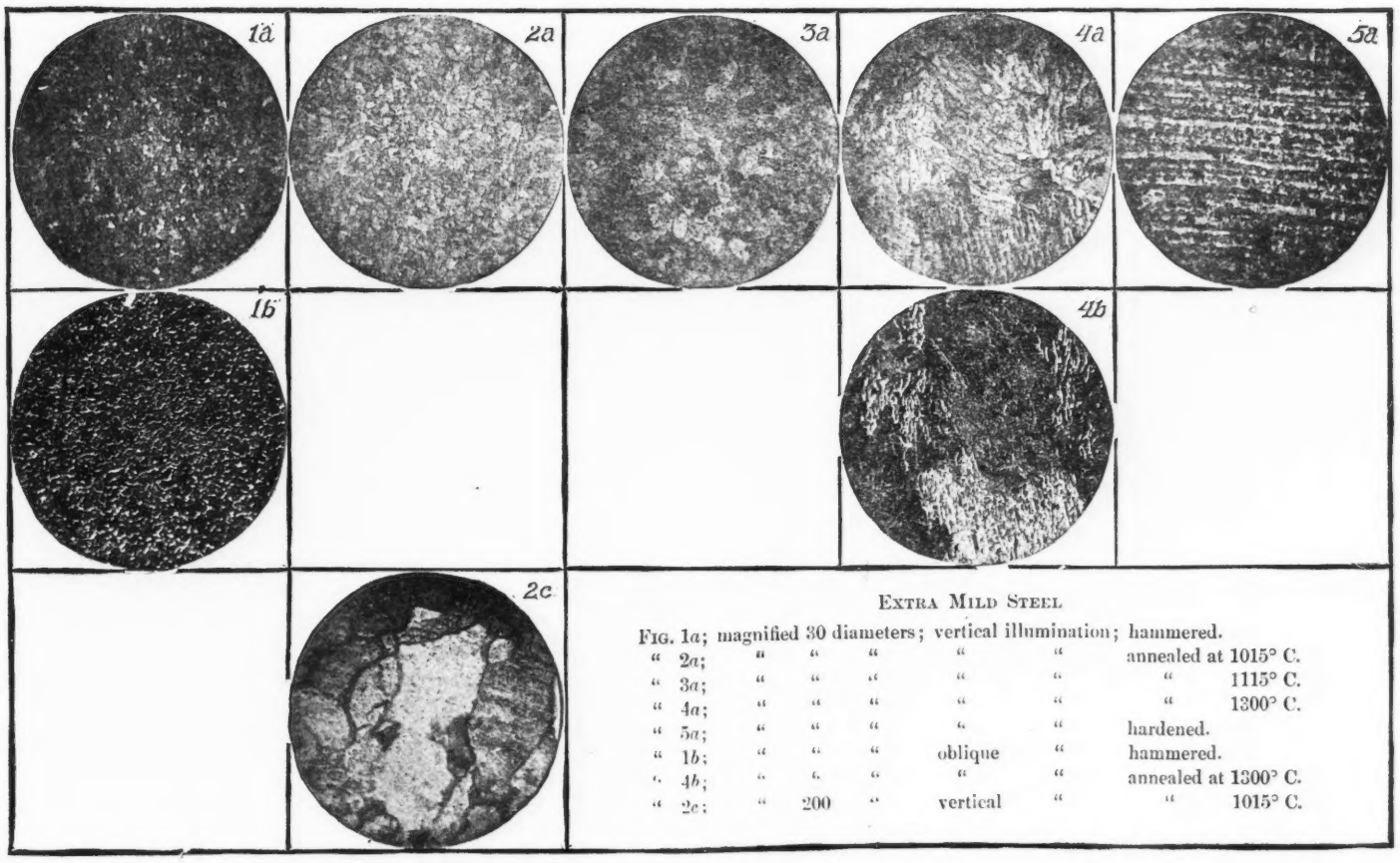


PLATE I.—MANGANESE-STEEL CASTINGS AND FORGINGS.

To Accompany Paper on "Iron Alloys, with Especial Reference to Manganese Steel," by R. A Hadfield, Pages 106-116.)

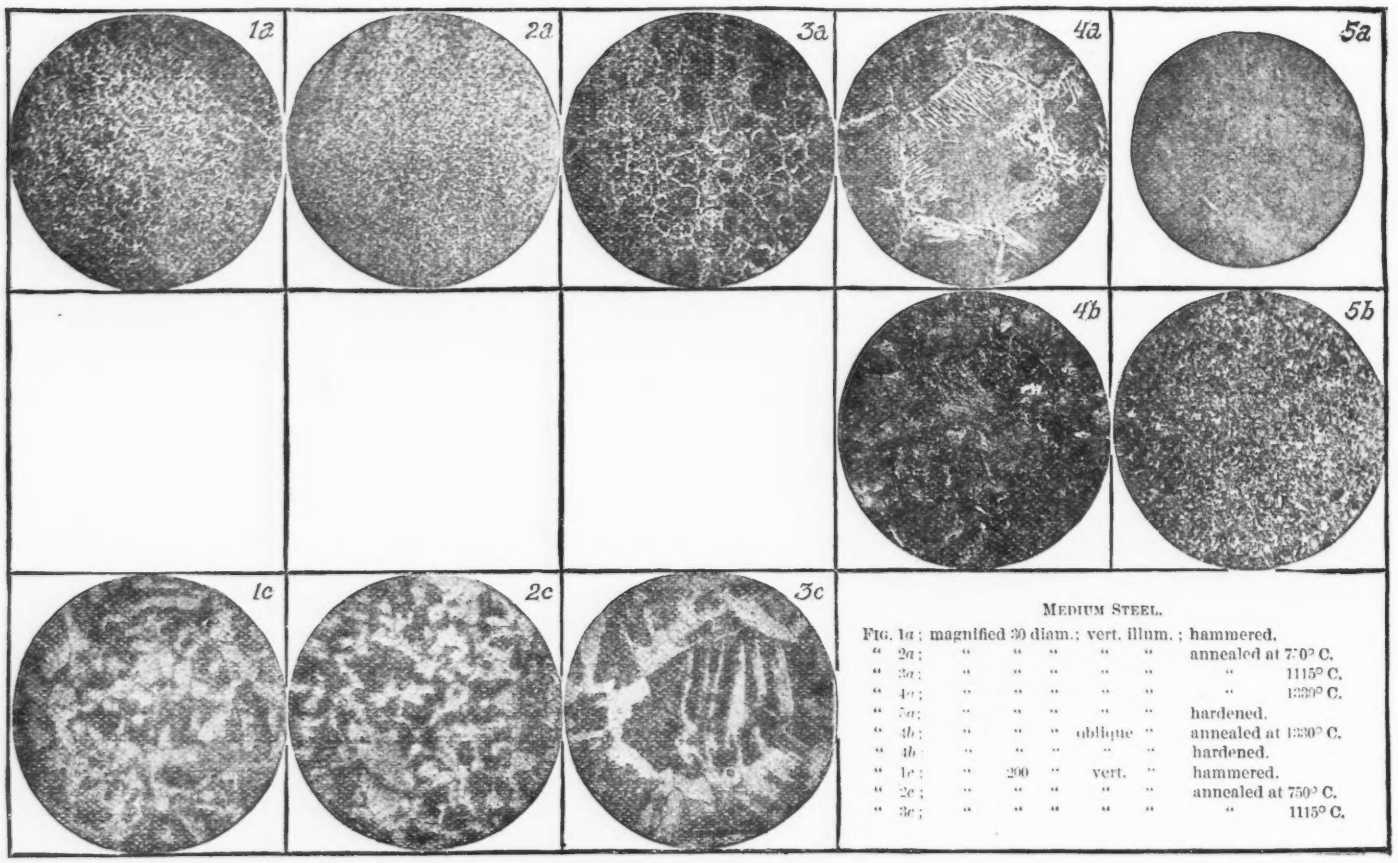


EXTRA MILD STEEL

FIG. 1*a*;	magnified	30	diameters;	vertical	illumination;	hammered.
" 2*a*;	"	"	"	"	"	annealed at 1015° C.
" 3*a*;	"	"	"	"	"	" 1115° C.
" 4*a*;	"	"	"	"	"	" 1300° C.
" 5*a*;	"	"	"	"	"	hardened.
" 1*b*;	"	"	"	oblique	"	hammered.
" 4*b*;	"	"	"	"	"	annealed at 1300° C.
" 2*c*;	"	200	"	vertical	"	" 1015° C.

PLATE I.—MICROSCOPIC METALLOGRAPHY.

(To Accompany Paper by F. Osmond, Page 106.)



MEDIUM STEEL.

FIG. 1a;	magnified	30	diam.;	vert.	illum.;	hammered.
" 2a;	"	"	"	"	"	annealed at 770° C.
" 3a;	"	"	"	"	"	" 1115° C.
" 4a;	"	"	"	"	"	" 1220° C.
" 5a;	"	"	"	"	"	hardened.
" 4b;	"	"	"	oblique	"	annealed at 1330° C.
" 4b	"	"	"	"	"	hardened.
" 1c;	"	200	"	vert.	"	hammered.
" 2c;	"	"	"	"	"	annealed at 750° C.
" 3c;	"	"	"	"	"	" 1115° C.

PLATE II.—MICROSCOPIC METALLOGRAPHY.

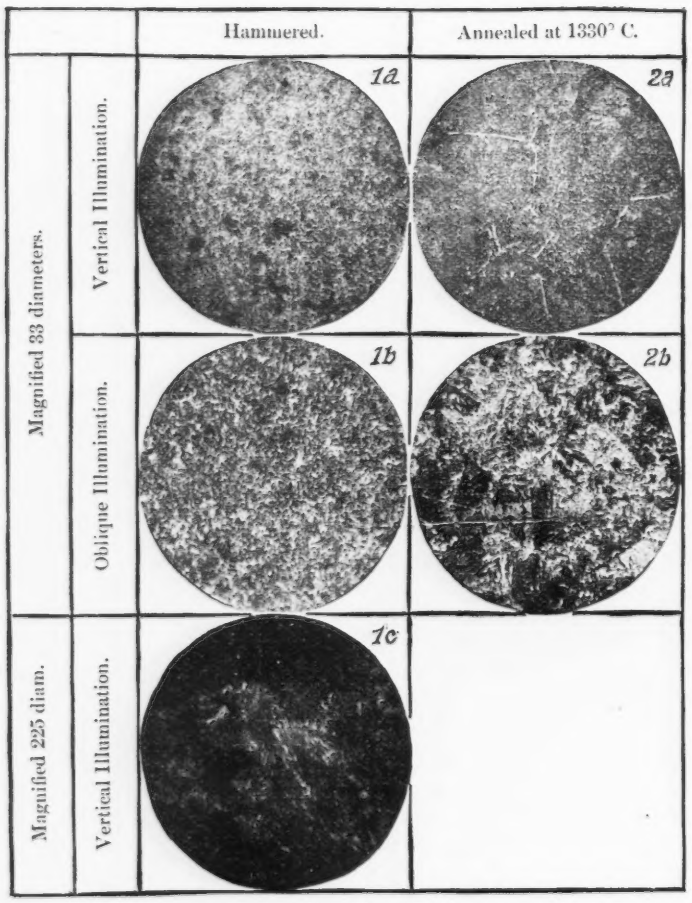
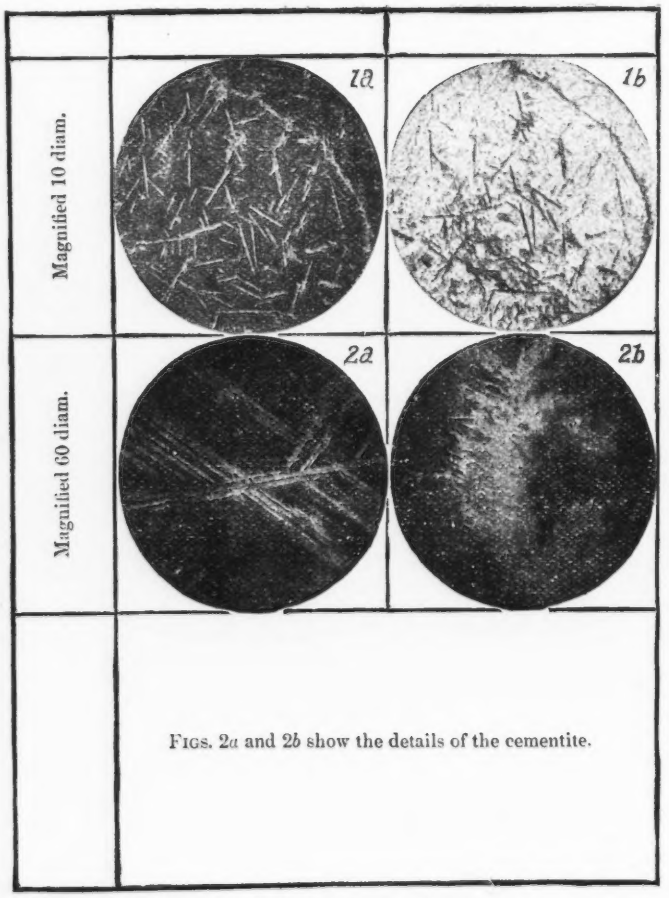


PLATE III.—HARD STEEL.



FIGS. 2a and 2b show the details of the cementite.

PLATE IV.—BLISTER STEEL.

MICROSCOPIC METALLOGRAPHY.

(To Accompany Paper by F. Osmond, Page 106).

TABLE I.—TESTS OF A SAMPLE OF ALMOST PURE IRON PREPARED BY PROFESSOR ARNOLD FROM D. V. SWEDISH BAR, CONTAINING BEFORE FUSION 0·04 PER CENT. OF CARBON.

I. *Tests of Professor Arnold.*
II. *Tests of the same sample by Hadfield.*
III. *Sample of pure copper tested by Hadfield for comparison.*

		I.	II.	III.
Series mark		136	1,371 F	.....
Analysis, per cent	C.	0·07	0·07	.....
	Si.	0·04	0·04	.....
	S.	0·02	0·03	.....
	P.	0·12	0·015	.....
	Mn.	0·06	0·07	.....
	Al.	0·03	.....	.....
	Fe.	99·76	99·81	.....
Specific gravity		.....	7·863	.....
Original diameter, inches		0·564	0·798	0·798
Original area, square inches		0·25	0·50	0·50
Limit of elasticity, tons per square inch		.....	18·	3·*
Breaking-load, tons per square inch		21·	23·	14·75
Total elongation, per cent., measured on 2 in.		50·	49·25	61·
Total reduction of area, per cent.		80·	69·60	61·20
Extension at permanent set, per cent.		.....	0·007	.....
Appearance of fracture		silky	silky	silky, and granular in parts.

*Probably; not measured exactly.

square inch, or as high as 50 or even 60 tons per square inch, when in the form of bars. Its ductility, when tested on a length of 8 inches, will reach a maximum of 30 to 35 per cent. in the case of mild carbon steel, or even 51 per cent. in the case of manganese-steel. Its reduction of area rises as high as 75 per cent. in very soft products.

There is much difficulty in giving a satisfactory explanation of the phenomena which are observed to attend the hardening of steel. Many theories have been put forward from time to time, and in the last few years the admirable researches of M. Osmond, in France, and Professor Roberts-Austen, in England, have led to great advances in the observation of the behavior of iron under thermal treatment, as well as of the molecular changes which attend the hardening of steel. The value of these particular researches cannot be easily over-rated.

The Beta Iron Theory.—Claiming both these investigators as personal friends, it is with regret that the writer dissents from the hypothesis advanced by them with reference to a portion of their work. The law of atomic volume in its relation to steel alloys, so ably formulated by Roberts-Austen, will be undoubtedly of service to metallurgists; and Osmond's able interpretation of thermal changes will prove of far-reaching consequence; but that iron assumes a "Beta,"* or hard form, in the alloy known as carbon-steel, and also in manganese-steel, the writer believes is as yet unproved. Iron may undergo allotropic modifications, but at any rate this cannot be conscientiously accepted until more direct proof is forthcoming. Upon the suggestions put forward hitherto, it is difficult to believe that the profound molecular changes which occur upon quenching the comparatively soft metal steel are not directly dependent upon the carbon present, or that the latter only plays an indirect or secondary part, as the Beta iron theory indicates.

M. Osmond, in his paper on "The Critical Points of Iron and Steel," speaks of the Beta iron theory as follows: "In opposition to the opinion generally accepted it is believed that it is not carbon but the allotropic Beta iron which is the principal cause of these new properties, that is, the new properties communicated to the steel by hardening." (Journal of Iron and Steel Institute, 1890, No. 1, p. 50.)

Professor Roberts-Austen, in the first report to the Alloys Research Committee, says: "Owing, indeed, to the temperature, the molecules of iron were only united loosely, and therefore it is true the red-hot mass as a whole was soft; but the individual molecules, if they could be readily got at, or could be resolved into their atoms, would be found to be hard."

It is difficult to suppose that two pieces of heated steel, one an ingot, too soft to become hardened by water-quenching, and the other tool-steel, hardening intensely at a low red heat, differ so profoundly as the terms just stated would indicate. In the practical manufacture of two such steels there is nothing to indicate differences so great.

As already remarked, Professor Arnold has recently produced an almost pure iron containing, say, less than 0·10 per cent. carbon. In the behavior of such an alloy, as compared with that of hard carbon-steel when being forged, there is, up to certain well-defined temperatures, but little difference. That most significant change, the loss of magnetic properties by the iron, occurs in both, at points not widely differing. The same remark applies to their electrical resistance. In fact, we have nowhere any proof, thus far, of such a change as would indicate that the one-ton steel ingot which we are to-day forging into a shaft, and which we shall to-morrow machine and otherwise manipulate, is in its heated state composed of atoms or molecules which, if they could be extracted in that condition, would be found intensely hard.

Take another aspect of the case. The Beta hypothesis, if correct, must, of course, apply to pig-iron. Can it be maintained that in cast or pig-iron of, say, three different grades, gray, mottled and white, the differences can be referred to the indirect action of the carbon upon the iron rather than to its direct action, viz., the direct combination of the carbon with the iron as carbide of iron, so fully proved in Dr. Sorby's microscopic researches, and in the recent report of Professor Ledebur, on the particular forms of carbon in steel? If we have no such combination, gray pig-iron is obtained, all or nearly all the carbon present being mechanically distributed as graphite. Iron of this grade is also modified by the presence of silicon, an element which we know positively does not produce hardness in carbonless silicon-steel. In other words, silicon, up to certain considerable percentages, produces little or no effect in carbonless iron. But in cast-iron the silicon modifies the effect of the carbon, changing it into the graphitic or the combined form, according to the amount present. In such cases, be it noted, silicon acts not upon the iron but upon the carbon; and it is to the particular state in which the latter exists that softness or hardness is wholly due. Strange to say, the percentage of silicon (2½ to 3 per cent.) that would cause a softening effect in cast-iron has little or no effect in steel. If there is little or no carbon present the steel remains soft when quenched. If the usual hardening percentages of carbon are present, water-quenching produces the usual intense hardness.

White cast-iron, in which all the carbon is combined, is so hard as to serve, when cast in suitable shapes, as the material of cutting-tools. But if we chill strong gray iron of certain qualities quickly, we find that in that portion of the sample which has parted most rapidly with its heat, the carbon is in the combined form, whereas, the portion which cooled more slowly still shows the mechanically diffused graphite.

In the different grades of cast-iron there is no progressive increase of carbon to complicate our deductions. The total percentage of this element may be constant in each of the three grades; and the resultant differences are entirely dependent upon the particular form which the carbon assumes, a form which may itself again be modified by differences in the rate of cooling, as in steel. No theory of hard iron seems requisite to explain these results. Probably the change noticed in cast-iron (apparently not so complex as that of steel or steel alloys) is an index to us as to the direction in which we must look for eventual explanation of the results obtained in hardening steel.

The Beta hypothesis will be further considered in the sections dealing with carbon and manganese-steel. Some recent experiments with the latter by the writer may, however, be mentioned here, as they have considerable bearing upon this Beta iron theory, and the results are, he believes, unfavorable to it.

A bar of manganese-steel was endowed with the curious property of being magnetic in one-half and non-magnetic in the other half. It was originally non-magnetic throughout, and became magnetic by continued heating for a long period; and the part which is now non-magnetic was again brought to this latter state by being heated for a few seconds to a high heat, forged and water-quenched. These experiments are detailed more fully in the section relating to manganese-steel, but the facts are mentioned here as they seem to have an important bearing upon the Beta iron question. It was suggested three or four years ago that the probable explanation of manganese-steel being non-magnetic was that the manganese held the supposititious Beta iron in the non-magnetic state, a state which is known to exist when a certain temperature (about 750° C.) is exceeded.

It seems quite possible to imagine that iron without actually changing its form may, when in combination with carbon (the only element which has been found to confer this property of true hardening upon iron), assume such a structure or form of crystallization as to undergo the modifications which are met with in hardened carbon-steel. The microscopic researches of Dr. Sorby, one of Sheffield's most respected citizens, as well as later ones by Professor Arnold, of the same city, indicate this latter direction to be the true one in which to look for a satisfactory explanation. The very fact that rapidity of crystallization is an essential to produce hardness seems an indirect proof that it will be by this branch of research—microscopy—that we shall next get more light.

Effect of Carbon.—Self-hardening steels, such as those obtained by alloys of iron with chromium and tungsten, still require the simultaneous presence of carbon. Such elements act as aids to hardening, but even self-hardening steels do not surpass, if they equal, the hardness of water-quenched carbon-steels, such as the pure Sheffield crucible-steels. Even the brittle 4 per cent. manganese-steel fully described in the writer's different papers, becomes comparatively soft in its forged state, and if cooled slowly enough, this latter material containing about 0.55 to 0.40 per cent. of carbon is the only one among numerous steel alloys produced by the writer, which has shown indications of approaching the ordinary high-carbon steel in its water-quenched hardness.* As shown in Professor Roberts-Austen's excellent "Metallurgy," even 0.3 per cent. of carbon must not be treated in any way as a negligible quantity. No one has shown more clearly than Professor Roberts-Austen how powerful may be the effect of small quantities of a second element upon the main constituent metal of an alloy. Such a percentage may have considerable influence in producing hardnesss; for we know that in the presence of manganese, carbon readily assumes the hard or combined form as a carbide of iron.†

The writer suggested some years ago the probability of manganese being a metal resembling nickel and chromium. Since that time there has been further evidence to show that it is a metal of different characteristics from those stated by the text books, and probably not of that extremely hard nature usually imagined, just as chromium, before thought to be a hard metal, has now been clearly proved by Placet's specimens, electrolytically produced, to have quite a different nature. The samples given to the writer by M. Placet show a comparatively soft metal. Hitherto, investigations regarding the physical properties of manganese have been very imperfect. The writer has never been able to obtain a sample of this element in its pure state; but by the work of two American investigators, Messrs. Wahl and Greene, it is hoped that before long carbonless and metallic manganese will be available. The studies of the properties of manganese will almost certainly throw much light indirectly upon this important question of the hardening of steel.

Second Form of Iron Not Proved.—As regards the bearing of allotropy upon this question, certainly no definite proof has yet been given that iron has more than one form. Recent research at the Sheffield Technical School has all gone to prove the facts noticed by the writer in his numerous alloy experiments that true hardness, which may be roughly termed "glass-scratching" hardness, is conferred by carbon alone. The one partial exception is the 4 per cent. manganese-steel; but this also contains 0.3 to 0.4 per cent. of carbon, and for other reasons before stated, it does not seem to constitute an exception which can yet be brought forward to upset the theory of "president" carbon. As the result of some recent experiments the writer hopes before long to produce a carbonless alloy, so that this important point may be definitely decided.

* In this paper *Beta*, or hard iron, is meant to indicate a product such as occurs in an alloy or steel which by water-quenching at a suitable temperature has been rendered so hard that it will scratch glass, or form the edge of a tool or other cutting instrument.

* The character of this hardness is, moreover, not like that of carefully hardened carbon-steel, but resembles that of overheated (often termed, incorrectly, "burnt") carbon-steel. It crumbles easily, and is lacking in cohesion.

† See Mr. Howe's note on Mukai's studies of manganese-steel. Transactions American Institute Mining Engineers, xxi., 625.

Allotropy.—The case of sulphur has been named as strongly supporting the probability of allotropic modifications in such a metal as iron, It should, however, be clearly borne in mind that, so far as our metallurgical knowledge goes, the material called soft or wrought-iron has always the same qualities, unless modified by the presence of a second element such as the metalloid carbon or by some of the metals such as chromium, manganese and nickel; the former metal producing "glass-scratching" hardness, and the latter metals but little change when present in small quantities, and only stiffness when in large percentages.

Again, surely the allotropic change that occurs in the element sulphur is not of the same nature and cannot be compared with the extraordinary change in physical properties of carbide of iron in the form of steel. In the case of sulphur, the changes are temporary and unstable, and the differences in physical properties are trivial as compared with those which occur when carbon-steel is hardened. A comparison with cases of this kind can hardly be taken seriously when we think of the profound differences existing between pure iron with its tenacity of some 18 to 21 tons per square inch, and a carbon-steel which has been hardened and tempered, possessing a tenacity of 150 tons, or (in the case of the best quality of pianoforte-wire) over 200 tons per square inch.

In some other elements forming allotropic modifications the changes seem to be likewise very unstable and uncertain. As Professor Tilden says in his excellent "Introduction to Chemical Philosophy," speaking of the allotropes or isomerides, and changes in structure of bodies: "One form is generally less stable than the other, and sooner or later, especially under the influence of change in temperature, is converted into the permanent variety."

In many instances the more rare allotropic forms as compared with those better known are unstable. Tin is often quoted as a metal subject to allotropic changes. The gray, brittle form has a specific gravity of 5.8. By heat or pressure it passes into the white or malleable form of 7.3 specific gravity. This again, by considerable reduction of temperature, reverts to the brittle species, as pointed out by Professor Roberts-Austen, with regard to the behavior of the buttons on the overcoats of certain Russian soldiers. Sulphur is more unstable even than tin. True, if cooled suddenly from a temperature of 240° or 250°, the product is a tough, elastic material, quite different in aspect from ordinary sulphur, and also insoluble in carbon bisulphide. But, as pointed out by Professor Tilden, this form, "after being kept a few hours, becomes brittle and crystalline, and recovers its solubility in the usual solvents."

That the importance of allotropy may be overestimated has been recently shown by Dr. Alder Wright, who, in his research on alloys of aluminum and antimony, found that certain of these alloys disintegrated spontaneously on exposure to air, and that the loss of coherence was not due to the assumption by the alloy of some allotropic form, but was merely the effect of oxidation.

No such unstable properties characterize steel in its hardened as compared with its unhardened state. The former has pronounced characteristics of a different and permanent kind. Does not this indicate that, even if allotropic changes occur, they are such as to warrant the belief that the soft metal iron, per se, has become entirely revolutionized in its condition and properties.

In stable allotropic transformations, the change in physical properties is usually very profound and decisive. If, therefore, Beta iron were proved to exist, it is difficult to imagine that there could be partial or varying degrees of allotropic modification, such as exists in the same steel quenched at varying temperatures. It does not seem possible to admit the explanation that there may be varying proportions of both Alpha and Beta iron in the same specimen. The very theory which indicates where the change to Beta or hard iron is supposed to occur (marked by an arrest in the rate of cooling, and by an equally revolutionary loss of magnetic properties) must of necessity apply to the whole mass; for the whole mass becomes non-magnetic. But, as a matter of common knowledge, the value of carbon tool-steel is due not merely to its property of becoming hard when water-quenched, but also to thefact that by tempering—on no account to be confounded with the French "trempe"—almost imperceptible gradations of hardness can be obtained. Some day, when expert manual work is rated at a higher value than now, it will be discovered that the workman to whose care is intrusted the hardening and tempering of the innumerable articles made from steel, should be dealt with as an artist of no mean degree—an artist, who, when he has received an education of somewhat higher standard than at present, will have to be more generously recompensed. The writer has known case in which a skillful artisan has been able to detect by difference in the behavior of steel under hardening and tempering as little as 0.05 to 0.10 per cent. variation in the carbon. Mr. Metcalf,* too, has pointed out in his interesting book on the treatment of steel that a trained expert can sort by means of the eye different brands of carbon-steel ingots, varying as little as the above in their percentage of carbon.

II.—CARBON.

Carbon and Iron.—This is so far the only metalloid which has been proved to confer "water-hardening" qualities upon iron. From the marvelous character of the stonework and masonry brought to light by recent Egyptologists, it would seem almost certain that steel tools must have been used for producing this work. If this be so, the use of carbon-steel must date back at least 4,000 years. The writer has recently read the fascinating book of Mr. S. Lang, on "Human Origins," but cannot agree with his conclusions that such work executed at least 3,000 to 4,000 years ago, in then civilized Egypt and Assyria, was effected with copper or bronze tools. It does not seem possible that any method of producing hard bronzes would give a material for tools capable of chipping and facing granite or other hard stones.

It is believed that the three oldest pieces of "wrought-iron" in existence—whether these are carbon-steel or not the writer has not yet been able to ascertain—are a sickle-blade, found by Belzoni, under the base of a sphinx in Karnak, near Thebes; a blade found by Colonel Vyse embedded in the mortar of one of the Pyramids, and a portion of a cross-cut saw exhumed by Layard at Nimrod. All these are in the British Museum.

An interesting account was recently published of the tunnel driven from the so-called Spring of the Virgin, near Jerusalem, to the Pool of Siloam. A tablet at the mouth of the tunnel contains what is held to be the oldest example of Hebrew writing, possibly dating from the time of Solomon. The translation reads: "Behold the examination. Now this is the story of the tunnel. Whilst the miners were still lifting up the pick toward each other, the voice of one called to his neighbor, so they heard each other, and the miners struck each of them the other pick to pick." The tunnel was driven from each end in solid rock to a total length of about 1,708 feet. This is referred to because one can hardly imagine this work being accomplished with any other than carbon-steel tools.

Carbon in Cast-Iron.—The behavior of carbon in cast or pig-iron seems much more easy of explanation than in steel, where its action is very complex. For example, a cast-iron, otherwise of pure quality, containing 2½ per cent. of silicon, and therefore very gray, can hardly be chilled, and in most cases only slightly, even if cooled most rapidly. Yet the writer has, with a 2½ per cent. silicon-steel, containing at the same time about 0.8 per cent. of carbon, made tools the hardness of which when water-quenched was sufficient to turn chilled rolls with ease, this being an exceedingly severe test. One would have expected that silicon in this instance would have acted as in pig-iron, or even that where the carbon was less, the influence of silicon would have been more powerful. Yet the opposite effect takes place.

The hardness and softness of ordinary grades of cast-iron seem clearly dependent upon the particular form of carbon present. So far two forms are well known, the graphitic and combined, though the latter requires classifying into the further grades now so clearly proved by Ledebur to exist. It is true that in "chilling" cast-iron, as in steel, we do not know why a soft metal like iron is converted by the presence of carbon into an extremely hard product. But in cast-iron it has always seemed, at first sight, easier to understand than in steel, because graphite, with which we do not associate the characteristics of hardness, is always present in soft iron, whereas this partly disappears in mottled, and entirely in hard white cast-iron. Graphite being well known as a soft form of carbon. there has not been so much difficulty in understanding why in its diffusion through a mass of iron it does not confer hardness. When, however, we ask why that form usually designated as "combined carbon" does so, we meet the same difficulty as in studying the hardening of steel. Finally, this brings us to the conclusion, in itself of no little value, that the same causes which produce hardness in steel also do so in cast-iron.

Abel's Investigations.—The recent president of the Iron and Steel Institute, Sir F. Abel, did perhaps more than any other investigator to call attention to this question. In 1881 he presented his first report to the Mechanical Engineers' Committee on the Hardening of Steel, and again in 1883, his "Report on Further Experiments Bearing Upon the Question of the Condition in Which Carbon Exists in Steel."

These reports proved that in steel gradually cooled the carbon exists entirely, or nearly so, in the form of a very definite iron compound, rich in carbon, which is disseminated through the mass, having been eliminated from the iron, during the process of cooling, in a more or less distinctly crystalline form; that the carbide is again assimilated by the metal when it is raised to a very high temperature; and that if a metal be suddenly cooled there is no time for the elimination to take place, and the carbon or carbide remains dissolved in the metal more or less completely, according to the degree of rapidity with which the cooling process is carried out.

In his second report, he says that "Further experiments confirmed the correctness of the view that the carbon present in the cold-rolled samples of steel examined existed, not as simply diffused mechanically through the mass of the steel, but in the form of an iron carbide—a definite product, capable of resisting the oxidizing effect of an agent which exerts a rapid solvent action upon the iron through which this carbide is distributed."

Ledebur's Investigations—Prof. A. Ledebur, of Freiberg, has still further elucidated this important question in the papers submitted by him to "Stahl und Eisen," on the "Nomenclature of the Various Forms of Carbon in Iron" (Vol. VIII., November, 1888); and "Recent Experiments on Carbon in Iron" (Vol. XI., April, 1891), and still later by his treatise presented to the Berlin Institute for the Promotion of Technical Industries, for which he has received their special award.

He has clearly proved that what is known as combined carbon is

TABLE II.

Cast-Steel Not Forged.

	Specimen A.		Specimen B.	
	Before annealing.	After annealing.	Before annealing.	After annealing.
Hardening carbon	·14	·08	·36	·16
Carbide "	·44	·52	·62	·92
Graphite and temper-carbon	·00	·01	·00	·01
Total carbon	·58	·61	·98	1·09
Silicon	·23	..	·28	..
Manganese	·18	..	·20	..

Tool-Steel.

	As forged.	Hardened.	Hardened and tempered at blue heat.
Hardening carbon	·22	·65	·36
Carbide "	·71	·38	·67
Graphite and tempered carbon	·00	·00	·00
Total carbon	·93	1·03	1·03
Silicon	·11	...	...
Manganese	·11	...	...

*No one has done more than Mr. William Metcalf, of Pittsburg, to show the delicate and accurate treatment to which tool steel of good quality should be subjected to secure the best results.

made up of two entirely distinct forms of carbon which according to the proportions of each affect the properties of iron in a widely different manner. The more powerful of the two is the hardening carbon which is alloyed with the main substance of the iron, and of which comparatively small quantities have very powerful effects upon the properties of the iron.

Ledebur gives a considerable number of examples and his analysis of steel show, instead of merely "carbon," three headings: 1, Hardening-Carbon; 2, Carbide-Carbon; 3, Graphite and Temper-Carbon, as shown in Table II.

These analyses throw much light on the changes in the form of carbon which occur in the thermal treatment of steel. They show how much is wanting in our present methods of commercial analysis. With the increasingly severe tests stipulated by the mechanical engineer, more attention will have to be paid to the different states or forms assumed by carbon in steel.

III.—MANGANESE-STEEL.

Next to carbon, manganese has been found the most useful of elements in the manufacture of steel and its alloys. Heath (about 1840) was probably the first to recognize its importance fully. He applied the black oxide to the manufacture of crucible cast-steel. Robert Mushet followed, employing manganese on a still wider scale to cheapen the manufacture of cast-steel. Henderson was the first to produce for commercial use the rich ferro-manganese now so important to steel-makers, and this line was followed up by Prieger. The Terre Noire Company improved upon these earlier processes, and it is to this company, whose exhibits at Paris in 1878 were a marvel in the combination of technical and scientific skill, that we owe the production of a rich and cheap ferro-manganese. Without this product it would not have been possible to manufacture the excellent soft steels produced in such enormous quantities during the last ten years.

The Terre Noire Company at the exhibition referred to showed an interesting set of steel samples containing up to about 2½ per cent. of manganese. But, at this point, owing to the brittleness of the product, whether cast or forged, their experiments stopped. Naturally enough they imagined that further additions would only produce still more harmful effects.

At the Hecla Works, Sheffield, however, owing to peculiar and unexpected results which had been obtained with other steel alloys, systematic experiments were carried on, which resulted in the discovery of what is now known as manganese-steel. It was found, as metallurgists are well aware, that very startling changes were obtained by the addition of varying percentages of manganese, many of them being quite surprising. A description of this material naturally falls under two heads, covering respectively its unhammered cast state and its forged state.

Cast Manganese Steel.—This may contain as high as 1·25 per cent. of manganese without showing any marked change in quality, provided the carbon is low. The writer has seen many excellent specimens of steel castings, containing as much as this percentage, giving good results, both under the drop-test and in the testing-machine. But after this percentage is passed, a decrease in strength and ductility occurs, and this is accentuated in a remarkable manner at a point somewhere between 3·5 and 5 per cent., when an exceedingly hard and brittle cast material results. The writer has pounded into fine powder, with a small hand hammer, thin sections of such steel, yet the same material is as ductile and malleable, when hot, as mild steel. This extreme brittleness is obtained when the steel has been cast very hot into thin sections or small ingots 2·5 to 4 in. square, and is partly caused by the peculiar crystallization accentuated by the thin sections or forms into which the extraordinarily fluid steel is run. The brittleness is not so marked if the metal is poured at lower temperatures; but no matter in what form or shape steel containing from 3·5 to 6·5 per cent. of manganese is cast, it is always considerably deficient in strength as compared with ordinary cast-steel. Beyond about 6·5 per cent., a remarkable change occurs. The exact point where the brittle nature of the material alters is influenced by the casting temperature and other considerations, and cannot be precisely stated; but toughness and ductility gradually return. There is probably no sharply defined point, but a merging effect similar to that observed in carbon-steel. Beyond 6·5 or 7 per cent., there is not only a remarkable increase of strength and ductility, but also a change in many of the physical qualities. The alloy becomes less and less subject to magnetizing forces; and at 13 per cent. it is practically non-magnetic under the strongest influence. As Dr. Hopkinson says:

"The magnetic property of iron is annihilated, and the comparatively small quantity of manganese present enters into that which must be regarded for magnetic purposes as the molecule of iron and completely changes its properties. The fact is one which must have great significance in any theory as to what is the molecular nature of magnetization."

Several years' experience in the manufacture of cast manganese-steel have led the writer to believe that a special explanation of its qualities of toughness and resistance to fracture by concussion is needed. It has been commonly imagined that what is known as the toughened material is secured in the casting without further treatment. This is not wholly true. Although sometimes the material, even in its cast state, is remarkably tenacious and ductile, notwithstanding its hardness, a further treatment, such as water-quenching, gives the best results. The material as cast is often tough, especially if cast in iron molds, but it is to some extent uncertain. The writer is inclined to believe that the variation noticed in its properties is somewhat dependent upon the casting temperature and other similar causes, some of which are not yet fully understood. In all cases, however, there is a remarkable difference between the strength of the 10 or 12 per cent. as compared with that of the 5 per cent. manganese-steel. The former, even if not very tough when cast, is always improved by water-toughening, whereas the latter, no matter what may be the treatment, is entirely lacking in strength and although useful for some purposes would usually be, by itself alone, of little service. It is at about 14 per cent. that the maximum of strength is obtained. After that point a decrease occurs; but the true cause of this is made complex by the higher percentage of carbon in the material, necessarily resulting, at present, from the high carbon even of the richest ferro-manganese. From results of special experiments carried out by the writer with manganese-steel containing less carbon than that usually found, it appears quite possible that if the carbon could be reduced, there would be considerable strength in the material containing 25 or even 30 per cent. manganese. It would possibly resemble carbonless nickel-steel to some extent. In fact, if a ferro-manganese without carbon, such as that obtained in the interesting experiments of Messrs. Wahl and Greene,* could be employed, it would probably be found, as in the case of nickel-steel, that with even still higher percentages than 25 or 30 per cent., iron-manganese alloys would possess considerable strength. At present, however, there seems to be no special advantage in a reduction of carbon, since the latter element is to some extent an advantage, as will be seen from the details given later in this paper.

The above statements relate entirely to the properties of cast manganese-steel, which, it must be remembered, differ in several ways from those of forged manganese-steel. The writer has not been able to ascertain the exact tenacity and ductility of cast manganese-steel. It has not been practicable to obtain satisfactory sets of cast test-bars, owing to the difficulty of preparing the specimens and the uncertain manner in which they behave in the testing-machine. For some peculiar reason, tensile tests do not seem to indicate the qualities of this cast material, as will be seen from experiments detailed below.

In any case, however, the tenacity is low, not exceeding 32 to 34 tons per square inch, even with the toughest and hardest description of cast manganese-steel. The tensile machine does not seem to gauge its tenacity accurately. A cast manganese-steel bar which will bend double cold and require much greater force to produce this doubling up, shows only about the same tenacity as a mild cast carbon-steel bar which can also be bent double cold, but with at least 30 or 40 per cent. less pressure.

Forged Manganese-Steel.—The exact qualities of this can be accurately determined, as test-bars can be forged carefully to shape and of any percentage up to 22 per cent. The writer has so fully detailed his tests in the papers presented to the Institution of Civil Engineers and the Iron and Steel Institute that it seems unnecessary to give more than a selection from current tensile tests showing the effects of the usual percentages of manganese in this steel.

The same general statements as to the effects produced by increased percentages of manganese apply to the forged as to the cast steel. The point where the greatest brittleness occurs is about 5 per cent. Heating or quenching treatment does not seem to modify this to any extent; and it is difficult to conceive that the same element, manganese, when doubled or trebled in percentage, can really produce such entirely opposite effects. With 10 per cent. of manganese the water-toughened material possesses about as much ductility as mild steel, though with much higher tenacity. Somewhat peculiar is the considerable difference which again occurs between a 10 per cent. and a 13 per cent. manganese-steel. In the latter there is a considerable increase both of tenacity and ductility. Nor can this be entirely ascribed to the increase of carbon necessarily accompanying the rise of manganese, for in two qualities (1.1 and 1.3 C) recently produced by the writer, between which there was little difference except the percentage of carbon, the respective tenacities were not very different.

For the same reason as was suggested with regard to cast manganese-steel containing 25 per cent. manganese or upward, it is probable that such products would be forgeable if the carbon were not so high. With about 22 per cent., malleability ceases. As was also observed concerning the cast steel, there seems no particular object in manufacturing forged manganese-steel containing more than about 14 per cent. of manganese. So far as we know at present, there are no further special changes in the physical qualities of the material, or the changes are not of such a nature as to make them of special service in the arts.

Attention is drawn to the fact that there is no great increase in tenacity by the increase of manganese unless accompanied by water-quenching. The reasons have been well discussed in an interesting paper on this question by Mr. Tetskichi Mukai, of Tokio, Japan.† It is water-quenching which gives the extraordinary tenacity and ductility noticed in the 13 per cent. specimens.

IV.—USES OF MANGANESE-STEEL.

As is well known, the application of manganese-steel has been restricted by the difficulty of machining and getting it into finished shape. In a large number of articles for which it is now used, these difficulties have been surmounted by so arranging the castings or forgings that they can be put to use without any tooling. In this way the adoption of manganese-steel has proved advantageous in many cases, a higher first cost being compensated by the saving of the cost of machining.

Manganese-steel has the considerable advantage of being almost as free from blow-holes or honey-combs as cast-iron. In ordinary cast-steel castings, blow-holes are still an appreciable factor. That its fluidity is much greater than that of cast-steel is shown by the fact that small wheels weighing about 5 oz. each are made of it, the arms of which are only 1-16-inch thick.

Its contraction is very considerable, nearly ⅝ inch per foot, thus increasing the difficulties in an already difficult question as every steel-founder knows. Its piping is also considerable. Contraction and piping go together in steel; the greater the contraction, the more the piping. However, with care, these two difficulties are not insuperable.

The first cost is necessarily much greater than that of ordinary steel; but with a growing demand this difficulty is also being gradually met.

Its hardness, although preventing the machining or fitting to exact shapes, has indirectly proved an economy, as already indicated, through the fact that articles made of it must be produced so as to avoid these expensive processes, except where grinding or special devices can be employed. For example, it is generally customary to turn ordinary

* Transactions American Institute Mining Engineers, xxi., 887.

† The substance of this paper was communicated to the Institute by Mr. H. M. Howe, in his "Note on Manganese-Steel." Transactions American Institute Mining Engineers, xxi., 625.

steel dredger-pins so that they may very exactly fit the bushes of the links and bucket-backs. By skill in manipulating the manganese-steel pins, the writer's firm has now turned out many thousands forged very truly to size. These are found for all practical purposes to be equally efficient as regards fit; the machining is saved, and a set-off is obtained to the increased first cost of this steel.

It is better to arrange where possible that articles of manganese-steel, whether cast or forged, be so designed that they can be put to work in their unfitted condition. In the case of links, wheels, pulleys, gearing, etc., arrangements are made for casting into the articles soft bushes or liners. The latter method, however, sometimes cannot be applied, owing to difficulties in the foundry.

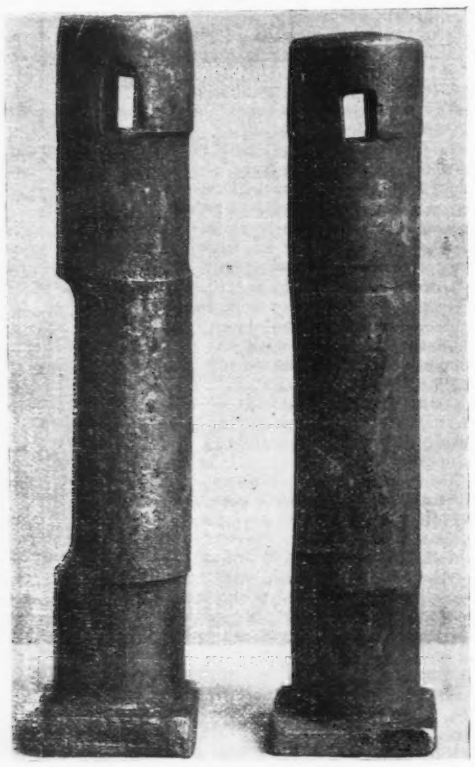


FIG. 1. FIG 2.

PLATE II.

Plate I. (Inset) shows manganese-steel castings and forgings. The ingot (Fig. 1) in the center, weighing about two tons, was successfully forged to a slab 4 inches thick, under one of the heavy steam-hammers of the Bethlehem Iron Company.

Figs. 2 and 3 are the tire and axle referred to in Tables XI. and XII. Figs. 4 and 5 represent 33-inch wheels of manganese-steel, now being tested in railroad service. Figs. 6 and 7 represent the rings being used for crushing hard silica and other fireproof preparations, as also referred to in Table III., A.

Dredger-Pins.—One of the first successful employments of this steel on a large scale was for dredger-pins. Although ladder-dredgers are not so much employed in America, large numbers are at work in Great Britain and on the continent of Europe.

It will be readily understood that the parts of this apparatus are specially subject to great wear and tear. The writer has seen 4-inch diameter dredger-pins or bolts made of ordinary carbon-steel, which connect the links and bucket-backs so as to form one continuous chain, worn more than half-way through their section in eight or nine weeks. Manganese-steel pins have not worn more than ⅛-inch in the same time.* The engineer of a large phosphate-mine in South Carolina reported after a very careful trial that manganese-steel would outwear not less than four pins of ordinary steel. The same remarks apply to the bushes used both in the bucket-backs and links. So successful has this application proved that Hadfield's Steel Foundry Company, of Sheffield, England, has now sent out more than 12,500 pins and 8,000 bushes of manganese-steel. Practical engineers, such as Mr. Leader Williams, of the Manchester Ship Canal; Mr. Charles L. Hunter, of the Bute Docks, Cardiff; Mr. R. Pawley, of the Hull & Barnsley Railway, at the Hull Docks; Messrs. Cochrane and Fowler, of the Preston Corporation Dredging Department; Mr. T. R. Salmond, of the Belfast Harbor Office; well known contractors, such as Messrs. S. Pearson & Son, of London, in their Mexican drainage canal contract; different dredging-contractors in Holland, India, Australia, and Canada, along with other users, one and all, have spoken of the results obtained as most satisfactory.

Mr. R. Pawley, of the Hull docks, reports a curious circumstance in connection with the use of these manganese-steel pins. "Curiously enough, although we find that manganese-steel pins are so much harder, there is actually less wear on the bushes of the link than with the ordinary steel pins." The excellent results detailed in Table III., and the result noticed by Mr. Pawley, indicate the value to the constructive engineer of the future of a material possessing in its forged and toughened condition a tenacity of 58 to 65 tons per square inch, a ductility of 40 to 50 per cent. on 8 inches, and yet at the same time exhibiting such exceedingly high resistance to wear and tear. Increasing speeds in machinery of all classes require an increasingly strong material in their construction. It is quite probable that when manganese-steel is better understood and has emerged from its infancy it will be advantageously employed for many parts of millwright work, effecting both an increased efficiency and a saving in weight. This latter is, in many cases, of great importance. Although the high tenacity of this steel may not be the true measure of its value over mild cast-steel, it is difficult not to believe that eventually its application will be wide in general constructive work, seeing that a piece of manganese-steel whose final elongation will be from 40 to 45 per cent. on eight inches, has only become permanently stretched ·02 inch, while a bar of mild steel with the same stress has elongated 2·24 inches, and has broken, that is, has been pulled in two.

In addition to pins and bushes, manganese-steel tumblers, saddles, whelps, links, tines, bucket-teeth, etc., have been made with satisfactory results.

A large tumbler weighing nearly two tons, cast in such a manner that it could without machining be keyed onto a shaft of ordinary steel, has given excellent wear. After 21 months use it showed a wear of 6·9 square inches on line of section (see Fig. 2, Plate III.). The ordinary cast-steel showed 29·5 square inches (see Fig. 3).

Crushing and Grinding Machinery.—Although in some special cases the results have not been so good as expected, yet in the main the wear of manganese-steel has proved as remarkable here as in its application to dredger-work.

This material has a curious combination of qualities; it is so hard that practically it cannot be machined, and to drill through a thickness of ¼-inch would spoil the best drill, yet in its cast state it has an internal looseness of texture. This is brought out in the tensile tests that have been made; the tenacity seldom exceeds 30 tons per square inch, though in the forged and toughened state this is doubled.

Again, in compression, as shown in the writer's paper before the Institution of Civil Engineers, there is a shortening of from 15 to 20 per cent. by a load of 100 tons per square inch on a 1-inch specimen. Such samples are exceedingly difficult to machine, nearly as much so as hardened carbon-steel; yet the latter with the same load would show no appreciable change. Mild steel would shorten about 50 per cent.; hard unquenched carbon-steel, about 25 per cent. of its length.

It is therefore difficult to describe the exact degree of hardness possessed by manganese-steel, and it is not always possible to predict without actual experiments what will be its behavior under certain tests.

For example, in some of the tests with stamp-shoes and dies its very hardness seems to have been against it, softer material having shown equally good results. It has been suggested that the hard, slippery manganese-steel clears its face so well that it has really to resist more wear and tear when acting in crusher-stamps than a softer material in which the hard particles of quartz crushed are to some extent embedded, even if only to a very slight degree; and that in this latter material, that is carbon-steel, the quartz itself to some extent does part of its own crushing, the face of the shoe itself acting as a backing or cushion.

Nevertheless, manganese-steel has given excellent service in the majority of cases, where it has been used for parts of crushing and grinding machinery.

Messrs. John Mowlem & Co., of Guernsey, have used manganese-steel for the cheeks of Blake crushers, and report that after crush-

TABLE III.—WEAR OF MANGANESE-STEEL DREDGER-PINS.

Name.	Number in Use.	Material.	Time in Use.	Official Report by Engineer.
S. Pearson & Sons, London.	3,850	Manganese-steel	6 months	"Scarcely perceptible."
Bute Docks, Cardiff (Mr. C. L. Hunter, Engineer).	601	Manganese-steel	4 months	"Little or no wear."
*Hull & Barnsley Railway & Docks Company (Mr. R. Pawley, Engineer).	230	Manganese-steel	7 weeks	"No perceptible wear."
		Ordinary steel	7 weeks	"Worn ¾."
		Manganese-steel	19 weeks	"Showed slight signs of wear."
		ditto	27 weeks	"Worn ¼."
		ditto	77 weeks	"Apparently would do a deal more work."
		Ordinary steel	10 weeks	"After 10 weeks have to be repaired three times and then put on scrap heap."
Preston Corporation (Ribble Navigation). (Messrs. Cochrane & Fowler, Engineers.)	418	Manganese-steel	18 months	"Worn ⅛ inch. Have worn out four sets ordinary steel pins, and to all appearance will outlast another four sets." These are shown in Plate VI. by Fig. 1. Fig. 2 in same plate shows the wear of ordinary steel.
Belfast Harbor Commissioners. (Mr. T. R. Salmond, Engineer).	24	Manganese-steel	8 months	"Worn ⅛."
		Ordinary steel	8 months	"Worn 5/16."
Manchester Ship Canal (Mr. C. J. Wills, Engineer.)	1,779	Manganese-steel	4 months	"Very little worn."
Phosphate Mining Co., South Carolina.	250	Manganese-steel		"Will last four times as long as ordinary steel."

* Mr. Pawley's series of very careful tests clearly shows that manganese-steel wore nearly three times as long as ordinary steel, to say nothing of the extra labor and expense incurred in repairing and replacing the latter. Thus it may be considered that the difference in favor of manganese steel is at least four to one, and this quite apart from the dredger's requiring no replacement of pins for such a long continuous period.

*Fig. 1 in Plate II. shows an ordinary steel pin, as used by the Preston Corporation, after 3 months' wear; Fig. 2, a manganese-steel pin, after 10 months' wear.

ing 3,000 tons of a very hard class of stone "their present condition is very little different from what they were when first put in, whereas cast-iron cheeks will only crush 300 tons before being worn out."

Messrs. Darbishires, of the North Wales Granite quarries, at Penmaenmawr, say that the manganese-steel plates of their Blake crushers after outlasting three pairs of cast-iron ones, were still not worn out.

At the Hecla works of the writer's firm, a pair of manganese-steel edge-runner rings 5 ft. 2¼ in. diameter, 15¾ in. face, have been tested in a mill used for grinding up hard silica bricks, quartz and other material of similar nature. It is too soon to say what will be their life; but after running for seven months and crushing 409 tons of the material named above, they have only worn down ⅝ in. in diameter, that is, 5-16 in. of the thickness of each side; while a pair of cast-iron rings 5 ft. 3⅜ in. diameter, used on similar work, after crushing 109 tons only had worn down ¾ in. in diameter. These are shown in Table III., A.

TABLE III. A.

Material.	Original dimensions. Ft.	Original dimensions. In.	Present dimensions. Ft.	Present dimensions. In.	Quantity ground. Tons.	Reduction in diameter. In.
Manganese-steel rings.....	5	2¼	5	1⅝	409	⅝
Best cast-iron rings.....	5	3⅜	5	2⅝	109	¾

A large roller-path of manganese-steel, for a cement-mill, is reported by the users, The Arlesey Cement Company, near London, to show no signs whatever of wear, after five months' continuous work.

For this class of work, such as edge-runner rings and bottom-plates, jaws, faces, toggle-plates and cheeks of stone-breakers, parts of disintegrators, balls, toothed-gearing for breaking up anthracite coal, rolls and similar articles, the use of this new steel will be found to give greater economy by reducing renewals, permitting higher speeds and more work to be got out of the same machine, and preventing breakages.

There has been already a considerable application of manganese-steel balls for crushing machinery. By a new method of manufacture it is now possible to produce these articles at a cheap rate and yet obtain a sound homogeneous ball of any required diameter.

Elevator Links —An important use in America, where so much elevator-work of all classes is done, should be the employment of manganese-steel for elevator-links. In England they have been adopted by several firms for coal-elevators, where the wear and tear is especially heavy. The Manvers Main Colliery Company, in the South Yorkshire coal-field, reports that after four years the manganese-steel links had been found far superior to ordinary steel links and would last three times as long as the latter. The durability, being so great as compared with ordinary steel, should be still greater as compared with malleable iron.

Owing to the non-magnetic qualities of the manganese-steel it has been found very useful for freeing electrical driving-chains.

Agricultural Work.—There are no uses where durability and strength are more requisite than in parts of agricultural implements. In remote parts of a country, especially where skilled labor is not easily available, it is of the utmost importance that the tools employed should possess the greatest possible durability. Here, again, therefore, manganese-steel offers a wide field for employment, its hardness, though not equaling that of the chilled iron, rendering it as serviceable as very hard cast-iron, without the liability of the latter to sudden fracture.

Shares, fingers, plow-points, and other articles made of manganese-steel have given good results, and quite recently spades, shovels, rakes hoes and forks have been introduced. A large Sheffield maker of such articles reports the opinion, from the tests he has already made with his steel, that these implements, if made of manganese-steel, would outlast from four to six of ordinary steel.*

A manganese-steel entrenchment-shovel, only 0.1 inch thick, was recently tested by firing at it nickel projectiles from the new English magazine rifle, which has a specially high velocity. At the short range of 100 yards the projectiles were unable to penetrate, and even when propelled by the cordite powder the penetration was incomplete at 200 yards. A shovel made of ordinary steel would have been easily pierced at five times, or if cordite explosive were used at nine or ten times this distance. The manganese-steel carried off the honors by being not only more durable as regards its use for entrenching purposes, but also acting as an excellent shield-plate.

Wheels.—Whatever may be the objections to forged manganese-steel for tires and axles, on account of the difficulty in machining it, this does not apply to cast manganese-steel, whether in wheels for railroads (engine, freight and passenger), horse cars, mining wagons, or other classes of rolling stock. In car wheels it has already given excellent mileage returns. The difficulty of obtaining in the hard manganese-steel a satisfactory and smooth hole for the axle fit was overcome by casting in the hubs a bush of soft material, or forcing in liners by hydraulic pressure.

English locomotive practice still adheres persistently to an expensive built-up wheel (though now wisely adopting cast-steel as a material for the centers of locomotive and other railroad wheels). It is therefore not possible at present to bring forward any definite English evidence as regards railroad practice with manganese-steel wheels. But the writer's firm has had in use on English railroads ordinary cast-steel wheels of solid construction, that is, cast complete in one piece, which have given no less than 120,000 miles service and are still good for much longer life. With the hardness of manganese-steel it is more than probable that 300,000 to 400,000 miles could readily and with perfect safety be attained.

A considerable number of horse-car wheels have been in use with satisfactory results, but here, owing to the cheapness of cast-iron wheels (not nearly so economical as many suppose, owing to the many breakages which pull down the average), headway is only just beginning to be made. As regards mileage, the manager of the Chester Tramways reported that 65,000 miles had been obtained with manganese-steel wheels sent for testing. This is a high result for street-car service, but there is no reason, in view of the hardness of the steel, why it should not be obtained regularly.

* Messrs. John Bedford & Sons, Sheffield, who make large numbers of spades, shovels and forks, report that so far as they have tested samples of manganese steel they believe they will outlast three or four made of ordinary steel.

It need hardly be said that a well-designed wheel of manganese-steel should be an excellent one for regular railroad service, and the American licensee of this steel, the Taylor Iron and Steel Company, High Bridge, N. J., has obtained some remarkable results under the drop and other tests.

Tests of Manganese-Steel Car-Wheels.—A 33-inch manganese-steel disc-wheel made by them under the Hadfield system, was placed horizontally upon supports and a tup weighing 1,120 pounds was allowed to fall 54 times upon the hub, when the latter was knocked loose on one side, but the wheel was still in one piece.

Another 33-inch manganese-steel wheel of armed design was dropped as follows upon a hard cast-iron foundation embedded in the ground.

TABLE IV.

2	drops	5	ft. each	Sum of the drops, 754 ft.
2	"	10	"	
2	"	15	"	
2	"	20	"	
2	"	25	"	
18	"	30	"	
2	"	32	"	

Notwithstanding this severe test the wheel was only slightly cracked in two spokes and on the edge of the tyre, and remained unbroken.

A 20-pound sledge-hammer test was made on an armed wheel at High Bridge last January, when the thermometer was considerably below zero, the wheel having been left out all night in the open air; and 150 blows were given without any effect except to slightly bend down the flange. The same wheel was at the same time further tested, sustaining 34 blows of a tup weighing 1,120 pounds, dropping from a height of 12 feet, before cracking. These, with previous severe tests of similar nature on manganese-steel castings, made by the mechanical engineer of the Pittsburg, Cincinnati & St. Louis Railroad, conclusively prove that manganese-steel is not brittle even at extremely low temperatures.

When it is considered that the best qualities of cast-iron car-wheels of similar design will not stand dropping more than about eight times from a height of 15 feet without breaking (in many cases not four times) it will seen that the extraordinary combination of hardneses and toughness of manganese-steel must before long make it specially valuable for this class of work.

Similar results have also been obtained at the Hecla works with some light manganese-steel disc-wheels, two feet in diameter. This shows two wheels which were tested by being dropped at varying heights upon a large steel ingot, as follows in Table V.

TABLE V.

No. 1,505. No. 2.	3 blows	3 ft. each.	Sum of the drops, 923 ft.	This wheel is still unbroken, being only slightly bulged on disc.
	2 "	5 "		
	2 "	7 "		
	2 "	10 "		
	6 "	25 "		
	24 "	30 "		
No. 1,505 No. 1.	3 blows	3 ft. each.	Sum of the drops, 773 ft.	Small crack in one of the disc plate holes. This wheel was then laid flat and a tup weighing 2,850 lbs. dropped from 5 and 10 ft. respectively, the disc and rim cracking.
	2 "	5 "		
	2 "	7 "		
	2 "	10		
	2 "	15		
	2 "	20 "		
	2 "	25 "		
	20 "	30 "		

The rim of wheel No. 1,505, No. 2, was then drilled in comparison with several other carbon-steel wheels of varying hardness. The results are shown in Table VI. Diameter of hole in each case, ¾-in. Drill, special high-class tool-steel.

TABLE VI.

Material drilled.	Mark.	Time occupied, in minutes.	Weight of drillings in grammes.	Gramm's per hour.
Rim of manganese steel disc wheel.....	1,505 No. 2	15	10·52	42
Hard turning tool steel.....	412	5	60·26	723
Rim of hard carbon (·80%) steel disc wheel	1,084	5	85·44	1,025
Medium cast steel (·45% C).....	8	5	94·84	1,138
Mild forged steel (·25% C).....	104	5	109·30	1,211

There is thus obtained a manganese-steel wheel, neither forged nor rolled, which notwithstanding 923 feet, sum of drops, is still unbroken, yet under the drilling test only loses 42 grammes per hour against 1,138 grammes of ordinary cast-steel, or 1,025 grammes of hard carbon-steel, containing 0.80 per cent. carbon.

The hardness of manganese-steel thus proved has been utilized for rivets by safe manufacturers in England. One of the leading firms there reports: "Our chisels won't touch it. We know this to our cost, as in a safe we made 18 months since, wholly riveted up by manganese-steel rivets, one was not properly closed, and in an endeavor to cut off the part projecting we destroyed two dozen chisels, and had to leave the projection on after all."

For mining-wagons, very successful results have already been obtained in America and England. The Lehigh & Wilkes-Barre Coal Company reports that the manganese-steel wagon-wheels, after a year of the hardest service, having been in use where they were constantly being spragged and slid down long slopes of steep incline, have so far shown no perceptible signs of either flattening or wearing. This company has also found these wheels 33 per cent. lighter than those of cast-iron, besides being free from breakages. Even at the higher first cost, manganese-steel has proved more economical than the best chilled iron wheels, which rapidly wear out or break in collisions, runaways, or other troubles of the kind constantly experienced in mining.

Similar results have been obtained by many other users. In Great Britain it would not be possible in the underground workings, often very long, and usually at great depths from the surface, to obtain the necessary output with tubs or wagons having cast-iron wheels, which are not only heavy and cumbersome, but are constantly breaking. The large outputs of modern collieries, especially those worked, as the majority are in England, by deep shafts, are dependent upon a continuous and uninterrupted output of coal from the different parts of the workings, some of them several miles from the pit-shaft. In the days of cast-iron wheels, breakages were constantly occurring, and large out-

TABLE VII.—TENSILE TESTS ON FORGED AND TOUGHENED MANGANESE STEEL MADE FOR THE PATENTEE, R. A. HADFIELD, BY INDEPENDENT EXAMINERS, INCLUDING MECHANICAL AND LOCOMOTIVE ENGINEERS, TESTING EXPERTS, ETC.

Tests by	Date of tests.	Mark.	Condition of material.	Analysis %. C.	Analysis %. Mn.	Original. Diameter.	Original. Area.	Elongation measured on	Limit of elasticity.	Breaking load in tons per sq. inch of original area.	Total elongation %.	Total reduction in area %.	Appearance of fracture.	Extension on 10″ by stresses of: 6,000 lbs. elongation %.	80,000 lbs. elongation %.	100,000 lbs. elongation %.	Special remarks.
D. Kirkaldy & Son London.	Dec. 1891	F W 2,458 F W 2,459 F W 2,460 F W 2,461	Water toughened	1·60	12·20	1·35 1·37 1·35 1·37	1·43 1·47 1·43 1·47	10″	20·31 19 55 19·91 19·42	61·49 59 13 59·20 55·52	41·3 40·0 38·3 37·1	33·0 33·1 33·6 35·0	60% to 70% silky, 30 to 40% granular	·46 ·61 ·62 ·63	6·04 7·42 6·58 8·39	17·7 19·9 18·2 20·4	It will be noticed that with the high stress of 100,000 lbs. per square inch the samples only strained an average of 19%.
Average of 4 tests								Ave.	19·83	58·80	39 0	34·3	Ave.	·58	7·11	19·0	
Professor Kennedy, University C'l'ge, London.			Water toughened	·88	13 95			8″		63·00	42·0			At 40,000 lbs. per square inch the permanent set in manganese steel was ·007″. Ordinary carbon steel with the same stress stretched permanently ·33″.			
T. Nash Testing Works, Sheffield.	April, 1893	1,395 F 1,396 F 1,397 F 1,398 F	Water toughened	1·10 1·10 1·37 1·37	12·02 12·02 13·30 13·30	·755 ·752 ·753 ·751	·448 ·444 ·445 ·447	8″		63·57 62·75 68·92 65·32	42·6 44·3 42 6 41·4	39·1 38 5 36 4 36 7	Silky	It will be noticed that the rise in the percentage of carbon produces but slight increase in tenacity: the ductility also seems unaffected.			
G. Barker (Gt. Indian Peninsular Ry.).	May, 1893	1,354 F	Water toughened	1·05	12·88	·780	·477	6″	·····	63·41	45·00	39·8					
J. F. Barnaby (Admiralty inspector).	·····	552/5 and 552/11	Quenched in sulphuric acid.	·85	13·75	·760 ·755	·453 ·447	8″	·····	63·66 65·05	50·00 50·07		Fibrous				
Brown, Bayley's Steel Works, Ltd., Sheffield.	Oct. 1892	1,290 F 1,291 F 1,292 F 1,293 F 1,294 F 1,295 F	Tested as forged Air toughened Water toughened	1·08	13 35	·770 ·789 ·780 ·781 ·780 ·780	·465 ·477 ·477 ·477 ·477 ·477	10″	·····	40·36 41·84 45·60 47·50 63·83 69·48	3·40 3·30 13·90 16·70 43 00 49·20	7·60 14·80 17·10 40·80 38·80	Granular.. Fine grain Silky.....	Tested as forged, broke at shoulders. Air toughened. Water toughened.			
Jno. Brown & Co., Ltd., Sheffield (for Capt. Tresidder).	May, 1892	959 F 960 F 961 F	Water toughened	1·10	13·33	····	·····	8″	····	73·80 70·20 68·60	24·00 20·00 23·00	32·00 42·00 45·00		Badly piped down center. Pipe down one side.			Special attention is drawn to the high tensile strength, the elongation, probably owing to insufficient toughening, being lower than usual.
W. H. Stanger, M. I. C. E., Westminster Testing Works, London.	June, 1892	1,424 F 1,431 F	Water toughened	1·15 1·43	12·61 12·52	·747 ·741	·438 ·431	8″	29·5 29·9	63·42 62 81	45·00 38·30	36·50 30·00 Ap.	Silky.....	An autographic strain stress diagram has been taken for this specimen. See Plate V.			

The above independent tests by steel manufacturers, locomotive engineers, experts in testing, and others give full proof of the remarkable uniformity, with high ductility and tenacity of this material.

puts could not be obtained with regularity. A single wheel breaking may lead to endless confusion in that particular working by causing 20 or 30 corves or wagons to get off the line, and blocking communication for many hours.

The writer's firm in Sheffield has supplied 20,000 cast-steel wheels to one firm of colliery proprietors, Messrs. Newton, Chambers & Company, of the Thorncliffe Collieries, South Yorkshire. Mr. A. M. Chambers, managing director of these collieries, and one of the leading mining engineers in the South Yorkshire district, says in a recent letter that during the last seven or eight years he does not recollect having one of the above wheels break in service, and he has no hesitation in saying that if his firm had to go back to the use of cast-iron wheels instead of steel, it would very materially reduce the large output of coal. He estimates the reduction in output to be at least 10 per cent. when breakages with cast-iron wheels are of daily occurrence. In fact, with the latter class of material it was not safe to have the "pits" worked by fast haulage, the breakages being so serious.

The writer's firm has turned out at least 2,000,000 of the Hadfield cast-steel wheels (carbon steel) for colliery and similar purposes; but it is now believed that as carbon-steel was found immeasurably superior to cast-iron, so manganese-steel will prove still better. In manganese-steel wheels the same advantage of lightness is obtained as with those of ordinary cast-steel, but the former is stronger and its durability is probably at least three to five times greater.

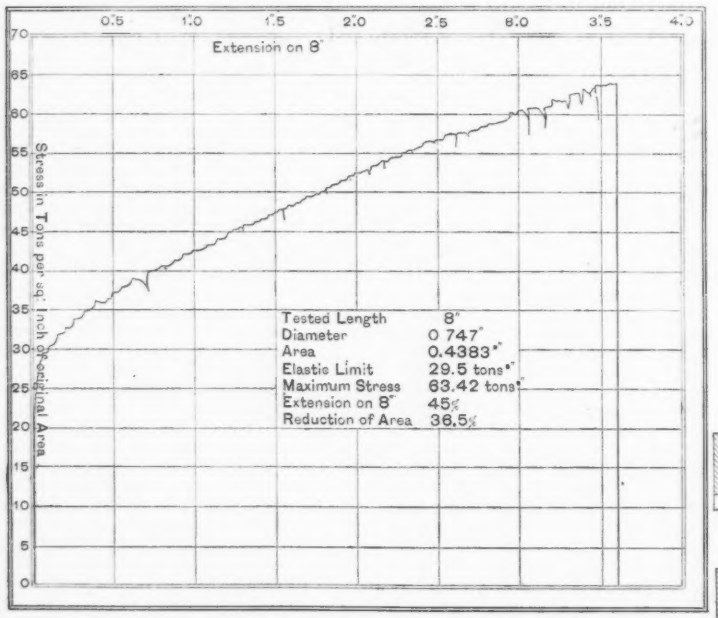


PLATE IV.—AUTOMATIC STRAIN-STRESS DIAGRAM OF FORGED AND TOUGHENED MANGANESE STEEL.

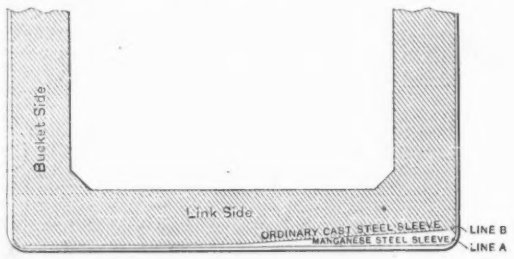


FIG. 1.

	sq. in.
Wear of Manganese Steel Sleeve on line of section in 13 months	4.3
" " Ordinary Cast Steel " " " " "	18.26
" " Manganese Steel " " " 21 "	6.9
" " Ordinary Cast Steel " " " " "	29.5

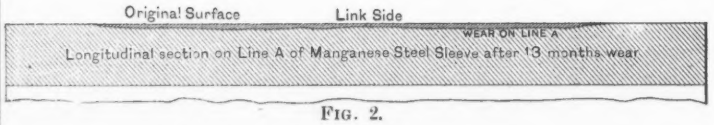


FIG. 2.

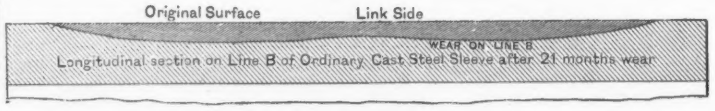

Original Surface
Link Side
WEAR ON LINE B
Longitudinal section on Line B of Ordinary Cast Steel Sleeve after 21 months wear

FIG. 3.
PLATE III.

RESULTS OF TENSILE, DROP, AND OTHER TESTS ON FORGED MANGANESE STEEL.

This material has been subjected to tests by entirely independent and unprejudiced parties, including such names as Mr. David Kirkaldy, the father of scientific methods of testing; Professor Kennedy, the well

TABLE VIII.—MANGANESE STEEL (ANALYSIS C. 1·00%, MN. 12·20%). RESULTS OF EXPERIMENTS TO ASCERTAIN THE ELASTIC AND ULTIMATE TENSILE STRENGTH, ETC., OF FOUR FORGED STEEL BARS RECEIVED FROM MESSRS. HADFIELD'S STEEL FOUNDRY COMPANY.

Test No.	Description.	Original. Dia.	Original. Area.	Stress. Elastic per sq. in.	Stress. Ultimate, per sq. in.	Ratio of elastic to ultimate.	Contraction of area at fracture.	Extension, sets at, length, ten inches. 60,000 lbs. per sq. in.	80,000 lbs. per sq. in.	100,000 lbs. per sq. in.	Ultimate.	Appearance of Fracture.
Z.	1⅜" dia., heads 2" sq.	Inches. Forged	Sq. in.	Lbs. Tons.	Lbs. Tons.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	
3,028	Water toughened F. W. 2,458	1·35	1,431	45,500	137,750	33·0	26·0	0·46	6·04	17·7	41·3	75% Silky. 25% Granular.
3,029	Water toughened F. W. 2,459	1·37	1,474	43,800	132,463	33·1	33·2	0·61	7·42	19·9	40·0	70% " 30% "
3,030	Water toughened F. W. 2,460	1·35	1,431	44,600	132,621	33·6	33·6	0··2	6·58	18·2	38·3	60% " 40% "
3,031	Water toughened F. W. 2,461	1·37	1,474	43,500	124,383	35·0	34 3	0·63	8·39	20·4	37·1	60% " 40% "
	Mean			44,350=19·8	131.804=58·8	33·7	34·3	0·58	7·11	19·0	39·2	66% Silky. 34% Granular.

Tested with forged surfaces; collars being the only part machined.

TABLE IX.—MANGANESE-STEEL (ANALYSIS: C. 1·00%, MN. 12·20%). RESULTS OF EXPERIMENTS TO ASCERTAIN THE RESISTANCE TO BENDING STRESS OF SIX FORGED STEEL BARS RECEIVED FROM MESSRS. HADFIELD'S STEEL FOUNDRY CO.

Distance between supports, 20 inches.

Test No.	Description.	Size.	Stress. Elastic total.	Stress. Ultimate total.	Ratio of elastic to ultimate.	Deflection at— 20,000 lbs.	25,000 lbs.	30,000 lbs.	35,000 lbs.	40,000 lbs.	Ultimate.	Angle.	Effects.
Z.....	2" square..... 25" long.....	In. B. D.	Lbs.	Lbs.	Per cent.	In.	In.	In.	In.	In.	In.	Degrees.	
3,047.....	F. 2,448..... "Just as forged".....	1·95 × 1·99 B D²=7·72	17,690 [18,238]	44,145 [45,746]	39·9	·130	·232	·516	1·17	2·30	5·10	60	Broken granular, fine.
	"Air toughened"												
3,048.....	F. A. 2,449.....	1·97 × 1·98 B D²=7·72	17,600 [18,238]	41,460 [42,964]	42·5	·132	·243	·542	1·12	2·11	2·80	30	Broken granular, fine.
3,049.....	F. A. 2,450.....	1·97 × 1·97 B D²=7·64	17,000 [17,801]	41,470 [43,424]	41·0	·131	·265	·587	1·22	2·43	2·90	31	Broken granular, fine.
		Mean	17,300 [18,019]	41,465 [43,194]	41·7	·131	·254	·564	1·17	2·27	2·85	30	
	"Water toughened"												
3,050.....	F. W. 2,451.....	1·97 × 1·99 B D²=7·80	9,500 [9,744]	39,700 [40,718]	23·9	·189	·323	·708	1·80	.....	.....	160	Cracked.
3,051.....	F. W. 2,452.....	1·98 × 1·98 B D²=7·76	9,500 [9,794]	39,670 [40 897]	23·9	·197	·334	·798	1 81	.....	.....	154	"
3,052.....	F. W. 2,453.....	1·96 × 1·96 B D²=7·53	8,900 [9,456]	38,785 [41,206]	22·9	·199	·340	·787	2·15	.....	.....	150	"
		Mean	9,300 [9,665]	39 385 [40,940]	23·6	·195	·332	·764	1·92	.....	.....	155	

Tested with forged surfaces, not machined. The figures in brackets are the equivalents of results calculated upon standard size of 2·00 × 2·00 in., or B D² = 8·00.

TABLE X.—MANGANESE STEEL—ANALYSIS C. 1·00%, MN. 12·20%—RESULTS OF EXPERIMENTS TO ASCERTAIN THE RESISTANCE TO THRUSTING STRESS OF TWELVE FORGED STEEL BARS RECEIVED FROM MESSRS. HADFIELD'S STEEL FOUNDRY CO.

Thrusting stress.

Test No.	Description.	Dimensions. Length.	Dimensions. Diam.	Dimensions. Area.	Stress, elastic per sq. in.	Depression at 50,000 lbs. per sq. in.	Depression at 100,000 lbs. per sq. in.	Depression at 150,000 lbs. per sq. in.	Effects.
Z.	1⅜ in. dia., 2 in. long	Inches.	Inches.	Sq. in.	Lbs.	Per cent.	Per cent.	Per cent.	
3,041	F. 3,222 Just as forged	1·869	1·34	1·410	58,100	0·37	6·63	13·54	Slightly barrel'd,
3,042	F. 3,223 Just as forged	1·982	1·34	1·410	58,000	0 35	6·00	12·76	"
				Mean	58,050	0·36	6·31	13·15	
3,043	F. A. 3,224 Air toughened	1 940	1·34	1·410	54,000	0·46	7·58	14·28	"
3,044	F. A. 3,225 Air toughened	1·914	1·33	1·389	54,100	0·42	7·47	14·11	"
				Mean	54,050	0·44	7·52	14·19	
3,045	F. W. 3,226 Water toughened	1·887	1·34	1·410	59,000	0·37	7·00	1ɔ·78	"
3,046	F. W. 3,227 Water toughened	1·920	1·33	1·389	59,000	0·42	6·67	13·54	"
				Mean	59,000	0·39	6·83	13·66	

Specific gravity.

Test No.	Description.	Weight. In air.	Weight. In water.	Weight. Difference.	Specific gravity.
Z.	1⅜ in. dia., 2 in. long	Grammes.	Grammes	Grammes.	
3,041	F. 3,222 Just as forged	338·804	295·739	43·065	7·8673
3,042	F. 3,223 Just as forged	362·872	316·749	46·123	7·8675
				Mean	7·8674
3,043	F. A. 3,224 Air toughened	352·679	307·841	44·838	7·8656
3,044	F. A. 3,225 Air toughened	345·276	301·350	43·926	7·8604
				Mean	7·8630
3,045	F. W. 3,226 Water toughened	339·232	296·607	43·225	7·8619
3,046	F. W. 3,227 Water toughened	346·516	302·463	44·083	7·8612
				Mean	7·8615

THRUSTING STRESS.

Test No.	Description.	Dimensions. Length.	Dimensions. Diam.	Dimensions. Area.	Stress. Elastic per sq. in.	Stress. Ultimate per sq. in.	Ratio of elastic to ultimate.	Depression, at 50,000 lbs. per sq. in.	Depression, at 60,000 lbs. per sq. in.	Depression, at 70,000 lbs. per sq. in.	Effects.
Z.	1⅜ in. dia., 10 in. long.	Inches.	Inch.	Sq. in.	Lbs.	Lbs.	Per cent.	Per cent.	Per cent.	Per cent.	
3,035	F. 3,075 Just as forged	10·00	1·34	1·410	56,000	71,787	78·0	0·16	0·39	1·90	Buckled.
3,036	F. 3,076 Just as forged	9·97	1·34	1·410	60,200	77,667	77·5	0·13	0·23	0·88	"
				Mean	58,100	74,727	77·7	0·14	0·31	1·39	
3,037	F. A. 3,077 Air toughened	9·88	1·34	1·410	53,300	67,847	78·6	0·18	0·81	....	"
3,038	F. A. 3,078 Air toughened	10·01	1·34	1·410	53,000	67,060	79·0	0·20	0·82	....	"
				Mean	53,150	67,453	78·8	0·19	0·81	....	
3,039	F. W. 3,079 Water toughened	9 82	1·34	1·410	52,600	67,347	78·1	0·24	0·51	....	"
3,040	F. W. 3,080 Water toughened	9·79	1·34	1·410	52,100	64,560	80·7	0·31	0·77	....	"
				Mean	52,350	65 953	79·4	0·27	0·64	....	

Tested with forged surfaces; the ends only being machined.

known London engineer; the late Mr. J. F. Barnaby; Mr. Stanger, of the Westminster Testing Works, London, and others. Table VII. gives a condensed summary of tests. The full and detailed tables of Kirkaldy are referred to later.

Professor Kennedy obtained a tenacity of 63 tons per square inch with 42 per cent. elongation on 8 inches. His result indicates a peculiar strained condition of the forged and water-quenched manganese-steel. This has nothing to do with the real permanent set or yielding-point. Professor Kennedy found this strained condition was entirely removed when a second time tested with the high load of 60,000 pounds per square inch. He says: "The whole extensions were then wholly elastic, the peculiar permanent set first noticed disappearing."

In June last, Mr. Stanger, M. I. C. E., of the Westminster Testing Works, London, took for the writer an autographic strain-stress diagram on a 50-ton Wicksteed-Buckton testing machine. There has been perhaps, in the history of steel no more interesting autographic record than that shown by Plate IV., giving the results of the above test. The breaking-strength was 63·42 tons (142,000 pounds) per square inch, elongation 45 per cent., and reduction of area 36 per cent. It is specially interesting to trace, as is only possible in an autographic record, the behavior of this peculiar material under such a high stress as is ordinarily obtained only with hardened and tempered steel, yet at the same time showing extraordinary ductility—more than mild steel—increasing its length nearly 50 per cent. cold. The peculiar strained condition of the water-quenched material is shown by the wavering line on the diagram. It will be noticed that there is a slight deviation or permanent set at about 20 tons, but it is not until 25 tons is reached that there is any marked yield-point, in fact, this appears to be nearer

30 tons. This is the stress returned in the report by Mr. Stanger, viz., 29·50 tons (66,080 pounds) per square inch as the elastic limit.

Another sample pulled in two at the same testing-laboratory showed a breaking-strength of 62·84 tons (140,760 pounds) per square inch, with elastic limit of 29·90 tons (66,980 pounds), and elongation of 38·30 per cent. One-half of this tested bar was reheated and quenched. It then bent double cold, showing that the material after water-quenching was in no way injured by the previous severe stress (140,760 pounds). Whatever may be the nature of the action upon such a material by the high stress to which it has been submitted, the internal structure and crystallization do not seem to be in any way injuriously affected.

A very complete set of tests of manganese-steel was also made for the writer's firm about 18 months ago by Messrs. D. Kirkaldy & Sons, of the Testing and Experimental Works, London. Mr. David Kirkaldy's reputation in this class of work makes these tests of more than usual value.

They comprise the following:

Table VIII. shows the results obtained from four specimens of water-toughened manganese-steel. It gives the elastic and ultimate tensile strength, ratio of elastic to ultimate contraction of area, total elongation, as well as extensions and sets with stresses of 60,000, 80,000 and 100,000 pounds per square inch respectively.

Table IX. gives the resistance to bending stress of forged, air-toughened and water-toughened manganese-steel, including elastic and ultimate strengths.

Table X. gives the resistance to thrusting stress.

Table XI. gives the resistance to deflection and the set produced under a gradually increasing bending stress on a 5¼ inch diameter manganese-steel bar (water-toughened). Owing to the high stress required, Mr. Kirkaldy thought it unwise for the safety of his testing apparatus to deflect the bar more than 15 inches. It was then removed unbroken. The results of the deflection up to this point may be of interest.

TABLE XI.—RESULT OF EXPERIMENT TO ASCERTAIN THE RESISTANCE TO DEFLECTION AND THE SET, UNDER A GRADUALLY INCREASED BENDING STRESS, OF A FORGED BAR OF WATER-TOUGHENED MANGANESE STEEL, FROM MESSRS. HADFIELD'S STEEL FOUNDRY COMPANY, LIMITED.

Length of bar, 7 ft. 11¼ in.; Diameter, 5·2 in.; Weight, 569 lbs.; Mark. F. W. 2.446; Composition, C 1 per cent., Mn 12·20 per cent.; Span, 6 ft. 6 in.; Load applied at center; Test number, Z. 3,053.

Stress in thousands of pounds	22	24	26	28	30	32	34	36	
" " tons (2,240 lbs.)	9·82	....	....	....	13·39	....	....	....	
Deflection in inches	0·23	0·25	0 29	0·33	0·36	0·40	0·43	0·47	
Set in inches	....	....	....	....	....	....	....	....	
Stress in thousands of pounds	38	40	42	44	46	48	50	52	
" " tons (2 240 lbs.)	....	17·85	....	....	....	....	22·31	....	
Deflection in inches	0·51	0·56	0 59	0·61	0·69	0·73	0·80	0·83	
Set in inches	....	0·25	....	....	....	....	0·38	....	
Stress in thousands of pounds	54	55	58	61	62	64	66	68	
" " tons (2,240 lbs.)	....	....	....	26·78	....	....	....	....	
Deflection in inches	0·88	0·94	1.00	1·06	1·13	1·20	1·27	1·35	
Set in inches	....	....	....	0·57	....	....	....	....	
Stress in thousands of pounds	70	72	74	76	78	80	82	84	
" " tons (2,240 lbs.)	31·25	....	....	....	....	35·71	....	....	
Deflection in inches	1·47	1·53	1 62	1·77	1·90	2·15	2 24	2 64	
Set in inches	0·85	....	....	....	....	1.44	....	....	
Stress in thousands of pounds	86	88	90	92	94	96	98	100	
" " tons (2,240 lbs.)	....	....	40·17	....	....	....	....	44·64	
Deflection in inches	2·94	3·42	4 01	4·51	5·34	6·35	7·30	8·15	
Set in inches	....	....	3·19	....	....	....	....	....	
Stress in thousands of pounds	102	104	106	107·08	....	....	....	....	
" " tons (2,240 lbs.)	....	....	47·32	47 80	....	....	....	....	
Deflection in inches	8·77	9·94	10·97	15·00	....	....	....	....	
Set in inches	....	....	....	....	....	....	....	....	
Elastic limit in tons	12·5	....	....	....	....	....	....	....	
Maximum stress applied in tons	47 80	....	....	....	....	....	....	....	
Ratio of elastic limit to ultimate stress	26·1	....	....	....	....	....	....	....	
Bar removed unbroken	....	....	....	....	....	....	....	....	

After these results in the testing machine it is not surprising to find that some very remarkable tests have also been obtained with forged and toughened manganese-steel in axles and tires.

As regards the shaping and finishing of the journals in axle-forgings, these can be swaged very near to finished dimensions. By means of special tools, with suitable grinding attachment, there need be no real difficulty in meeting this point. In tires for built-up wheels the objection is serious, the amount of machining being greater and also very difficult, at any rate, so long as built-up tired wheels are constructed as at present. Moreover, the extraordinary toughness of the cheaper cast manganese-steel wheels, described above, makes them advantageous as compared with the expensive built-up wheel.

The following details of experiments are given, therefore, not for the purpose of proving that the material can be used with advantage at present, at any rate for tires, but to illustrate its remarkable combination of stiffness, great toughness, and hardness.

Axles.—A manganese-steel axle 5¼ by 4⅛ by 6 feet 11¾ inches was forged to ordinary railway freight-car pattern. No difficulty of any kind was experienced in this operation. It was very malleable, though specially tough and dense, offering more resistance to blows of the hammer than is usual with this steel. It was an excellent forging, free from imperfections, and of specially smooth appearance. The journals could have been brought to the finished dimensions with very little grinding or other fitting. The supports were 3 feet 6 inches apart and the weight of drop used was 1,640 pounds.

After water-quenching it was sent to High Bridge, N. J., and there tested by the Taylor Iron and Steel Company.

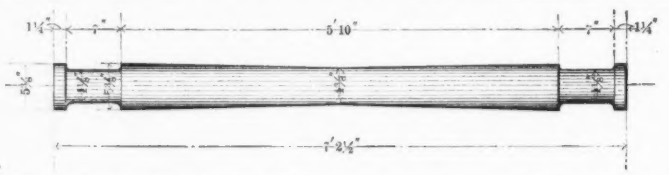
TABLE XII.

No of blow.	Height in feet.	
1	25	Deflection 7¾ inches.
4	25	" 1¼ "
6	25	" 6 "
12	25	" 1⅝ "
23	25	" not noted after 12th blow.
24	30	
29	30	Cracked.
33	30	Broke.

That is 20 blows from 25 ft.
and 13 " 30 "
33 in all.

Weight of tup 1,640 lbs.
Axle reversed after each blow.

The Brown Bayley's Steel Works Company, of Sheffield, tested for the writer an axle of the dimensions shown in the following sketch:

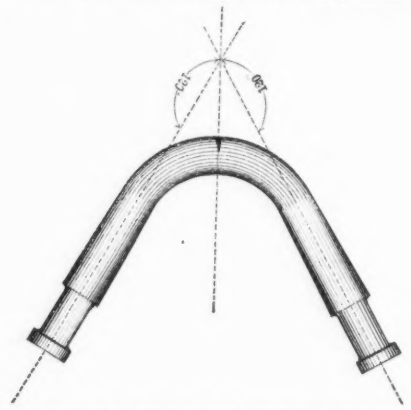


This axle was tested with a 2,000-pound tup, supports 3 feet 66 inches apart, and reversed after each blow.

TABLE XIII.

No. of blows.	Height of drop. Feet.	Average deflection. Inches.
6	20	3⅛
4	25	3½
6	30	3¾
10	32	4
26		

After the 21st blow, the blows were delivered on one side, the axle not being reversed. The axle thus deflected 9¾ inches at the 26th.



After the above test the axle was bent in a hydraulic press to 120 degrees, when a crack was discovered.

In view of the weight of the tup and the comparatively small deflections produced, the above is an exceedingly severe test. One of the strictest tests on ordinary carbon-steel axles of best quality is that made for the New South Wales Government under Sir John Fowler's instructions, viz.: From 20 feet, from 25 feet, and from 30 feet blows of a 2,000-pound tup, which the axle must stand without showing signs of fracture. The manganese-steel axle stood more than twice this, and then bent to 120 degrees before showing slight cracks.

Tires.—Brown Bayley's Steel Works Company tested also two manganese-steel tires, the material for which was made at the Hecla Works. Considerable difficulty was experienced in producing the tire to shape, that is, during the forging and rolling processes, owing to the toughness of the material when hot. The tires were first water-toughened and a 2,240-pound tup dropped on one of them as shown in Table XIV. This tire is shown in Fig. 2, Plate I. and sketch in Table XIV.

TABLE XIV.

Size of tyre: 2 ft. 8 in. internal dia. by 5¼ in. wide, by 2¼ in. thick.
Weight of tup, 2,240 lbs.

Height of fall in feet.	Deflection in inches.	
10	1 3/16	The tyre was afterwards placed under the hydraulic press and bent as per sketch.
12	2 7/16	
14	3⅝	
16	5 1/16	
18	6⅝	
20	7¼	
22	10¼	
24	12¼	
26	14⅛	See also Fig. 2, Plate I.
28	16	
30	18	
32	20⅛	
32	22⅜ unbroken.	

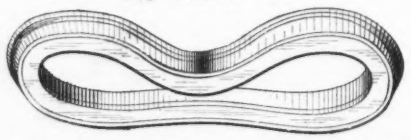


Table XV. gives tests of a manganese-steel tire for which the steel was produced at the Hecla Works, Sheffield, and rolled by the Superintendent of Locomotive Power, L. & Y. Railway, Harwich.

TABLE XV.

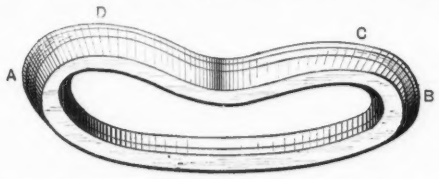
No. of blow.	Height. Feet.	Deflection. Inches.	
1	5	⅜	After ninth blow tire turned over and received blows from opposite side.
3	15	¾	
6	30	1⅜	
9	30	1⅜	
12	30	1⅜	
15	30	1⅜	

Sum of drops, 375 ft.
Total deflection, 20⅞ in.
Tyre not broken.

It was then nicked at A and B with difficulty, received 3 blows from 30 feet at C, cracking at B 1½ inches into the tire, and after 5 more blows at D, the tire was completely broken at A and B.

Mr. P. H. Dudley has said of this material: "A tire made of manganese-steel so hard that it can hardly be machined, to stand such severe drop-tests as named without failing, and only breaking after being nicked, does much to correct our erroneous impressions that a

hard metal must of necessity be brittle. That a metal may be hard and tough is one of the most important facts for consumers of steel to learn to-day. If there can be produced a tire of largely increased



strength over the ordinary tire, safe beyond question, having three or four times the present wearing-capacity, there would be a great field in railroad service for such tires, irrespective of any increased first cost per pound of metal."

Mr. Dudley's wide experience entitles his remarks to special consideration, and the facts above mentioned necessarily apply just as much to a cast as a forged manganese-steel.

ELECTRICAL CHARACTERISTICS.

Non-Magnetic Character and Its Bearing Upon the Beta Iron Theory.—A peculiar fact noticed in this material is that when exceeding about 12 per cent. manganese, it is practically non-magnetic, even when submitted to the strongest magnetizing forces. This was tested by the writer some time ago when going through the Edison laboratories. A large magnet said to be capable of lifting nearly a ton weight would not attract even a piece of manganese-steel weighing but a few grammes. Even the 9 per cent. material is non-magnetic, taken in bulk, though its drillings are influenced considerably, thus indicating that to detach the material or break it up into smaller masses enables the magnetic force to exert its influence. This, however, does not apply or only very slightly to 13 per cent. drillings.

No satisfactory explanation of the non-magnetic qualities of this steel has yet been brought forward, though the material has been examined by most of the leading scientists of the day. It is certainly remarkable that iron which, in the form of carbon-steel, makes the best permanent magnets becomes, when existing as an alloy or combination of manganese, practically non-magnetic.

Some years ago the writer noticed that some manganese-steel car-wheels which had been running for a considerable period were, after their return, more susceptible to magnetic influence. Unfortunately a record had not been kept of the exact percentage in these particular wheels. Probably it was not more than about 11 per cent., this amount having been employed in some of the earlier experiments connected with manganese-steel castings. It would seem that the constant vibration experienced by such articles had to some extent influenced the particular property under consideration. This fact is not conclusive, for the writer has seen other wheels apparently as non-magnetic after several years of use as when first put to work.

Manganese-Steel Magnetic Under Certain Circumstances.—Quite recently, however, the writer has discovered some further peculiar properties of this material. It would appear that under certain conditions it can become susceptible to magnetizing forces.

A bar 1¼ inches square by 12 inches long, and of the usual non-magnetizable quality, was heated for 21 days by Messrs. T. Sorby & Sons in a Sheffield cementation-furnace of ordinary construction, being packed in charcoal along with bars of Swedish iron. Table XVI. shows the composition.

TABLE XVI.

	C.	Mn.	
Before treatment	1.08	13.08	Non-magnetic: not attracted by magnet; and a very sensitive ship's compass was not affected in the slightest degree.
After treatment	1.29	....	Compasses strongly deflected; and though not strongly affected by the magnet there was a distinct effect.

Although the analysis indicate that the carbon was but little increased, a remarkable change occurred, the sample becoming susceptible to magnetic influence. The needle of a compass not previously affected in the slightest degree was now strongly deflected, nearly as much so as by samples of ordinary unmagnetized iron and steel. This was an interesting result; but the next portion of the experiment was still more so. The same bar, 1¼ inches square, was heated at one end, forged down into a thinner section, ½ by ⅛-inch, raised to a yellow temperature (about 1,000° C.) water-quenched and bent double cold, as is usual with the manganese-steel under this treatment. This portion had again become non-magnetic. Thus in the same bar there resulted one portion unaffected by strong magnetic influence, while the other portion was susceptible to a considerable degree. So far as at present ascertained, the other physical properties of the material before and after treatment appeared to differ but little. Its hardness was the same, its fracture was but little changed. The cementation had but slightly increased the carbon, from 1·08 to 1·29 per cent., which is not sufficient to cause an expectation of any marked difference. The writer's firm has produced indiscriminately, with 1 or 1¼ per cent. carbon in the 13 per cent. manganese-steel, a material possessing physical properties which differ but slightly.

The sample as received from the cementation-furnace appears similar to ordinary forged manganese-steel. Previous to water-quenching it is somewhat brittle, but the latter treatment at once restores the toughness, at the same time destroying the magnetic qualities acquired by long heating at a comparatively low temperature, the latter not being more than 800° C., that is, during cementation. The duration of the heating is evidently the chief factor, the acquired magnetic qualities of a previously non-magnetic steel being at once permanently lost by reheating and quenching. The same fact was noticed (see Table XVII.) after heating a sample of manganese-steel which had been annealed in a malleable cast-iron annealing-furnace.

TABLE XVII.

Sample before annealing	·93 C. 13·93 mn.
" after annealing	·03 C. .... mn.
Original sample	Non-magnetic
After annealing	Strongly magnetic
After annealing, re-heating, water-quenching and re-heating	Strongly magnetic

This sample being not more than ⅛ inch thick was considerably oxidized. The scale was carefully removed before testing the sample for magnetic qualities. Thicker samples are now under examination by the same tests. This sample did not become again magnetic by water-quenching, but further experiments are in hand on this point.

As it would take up too much time and space to describe this interesting question here fully, the writer merely states the results. They will probably be found to have an important bearing upon a problem in which all metallurgists are interested, viz., some full and more satisfactory explanation of the facts noticed during the hardening of carbon-steel.

Bearing of Foregoing on Beta Iron Theory.—The result here attained seems to interfere seriously with the Beta iron theory. The non-magnetic properties of manganese-steel and also its peculiar hardness (not "dead" hardness, like hardened carbon-steel) have been adduced as proofs that Beta iron must exist. Manganese-steel, indeed, shows no recalescence. This, it is claimed, proves that just as ordinary iron is in the non-magnetic state above a bright red heat (750° C), manganese-steel retains the iron in that form at ordinary temperatures.

Here, however, we have a manganese-steel which, after being treated in a cementation-furnace having a higher temperature than that required to produce recalescence, has become magnetic. Having been above the recalescence-point it must also have been at a temperature sufficiently high to change the soft into the hypothetical Beta form of iron. In other words, it has been treated at such a temperature that a sample of carbon tool-steel heated at any period of the treatment which the manganese bar underwent in the cementation-furnace would if suddenly removed from the furnace and water-quenched, have become hardened. That is, the so-called Beta form would have been retained. Unless some very strong reasons can be adduced, it would seem that the Beta iron theory does not coincide with the facts now noticed.

It is also important by this experiment to have proved that the hardness of manganese-steel is independent of its magnetic condition, confirming Mr. Wingham's contention several years ago (Journal of Iron and Steel Institute, 1890, No. 1, p. 101) that the Beta iron theory is inconsistent with the facts noticed in magnetizing hardened steel. He rightly asked, How could permanent magnetism in hardened carbon-steel be reconciled with the fact that such material was found so exceedingly suitable for the manufacture of permanent magnets, if the iron present in that material was in the Beta form, the latter being supposed to be non-magnetic? If hardened steel is a material in which non-magnetic Beta iron is imprisoned, so to speak, how comes it that such a steel is of all others the most suitable medium for articles requiring magnetic retentiveness? Mr. Wingham further added that to make the hypothesis more acceptable it would be necessary to say that "apparently hardened steel must contain some Alpha or soft iron." This, of course, is quite inconsistent with the facts known. The harder the steel the more pronounced are its qualities of magnetic retentiveness.

The writer would point out also that, conversely, wrought iron, in which there is supposed to be no iron present in the non-magnetic or Beta form, even if quenched from a high heat, ought to make a good permanent magnet, as all the iron present is supposed to be in the Alpha and magnetic state. It is certainly subject to magnetic influence; but otherwise it has just the opposite quality.

The writer cannot but think that if two pieces of wrought-iron were tested for magnetic retentiveness, one having been water-quenched from a very high heat, the latter would be the superior—perhaps only slightly so, but sufficient to show that there had been some change, which was entirely due to the effect of rapid cooling, causing an alteration in the structure, just as the same results, only in a much more marked manner, occur in carbon-steel. In other words, this is due to alteration in the form of crystallization brought about by another set of conditions, the causes for which we are beginning to understand better by means of the microscope.

Abel's and Ledebur's researches do not give any reasons, but rather the contrary, to believe that hardness is in any way owing to a hard form of iron. Other experiments by the writer, including those on silicon, aluminum, copper, chromium, tungsten, and other tin-alloys, all prove that unless carbon be present no quenching hardness results. Manganese-steel has hitherto afforded a notable exception, though never equaling the hardness of carbon-steel.

The magnetic properties of manganese-steel have been very carefully investigated by Drs. Hopkinson, Bottomley and Fleming, Professors Barrett and Ewing, and many other leading scientists. This material has specially invited scientific investigation, owing to its peculiar presentation of iron, the most magnetic element known, entirely or practically deprived of its magnetic qualities.

As far back as 1773 Rinman noticed this; and in 1830 Mushet produced ferro-manganese which was non-magnetic; but such alloys were neither malleable nor ductile. The manganese-steel, when worked hot, can be reduced to the thinnest sections or drawn to fine wire (No. 32 B. W. G.). For this, however, great care is required; but ordinary gauges, to about No. 20 B. W. G., present no special difficulty.

It is surprising to find 14 per cent. manganese-steel almost as inert to the highest magnetic forces as copper or other dia-magnetic metals. Even in the most favorable samples its permanent magnetism is exceedingly small. To use a metallurgical simile, this quantity may be described as one would talk of the effect of ·02 per cent. of manganese upon ordinary carbon-steel.

Professor Ewing gives its permeability as 1·46 (the force ranged up to 16,000 C. G. S. units, and with this the magnetic induction rose to nearly 15,000 C. G. S. units, the ratio of induction to force being as thus given).

TABLE XVIII.

Material tested.	Experimenter.		
Manganese-steel	Ewing.	Permeability	1·46
"	"	Magnetic susceptibility	.036
Soft wrought iron	"		280
Manganese-steel	Barrett	Magnetization per gramme	0·13 C. G. S. units.
Ordinary steel	"	" "	40 to 60 and even up to 100 units.

Thus the ratio of magnetization is as 1 to 3,000 and up to 7,000 in the best sample of manganese-steel, in comparison with ordinary steel.

Professor Barrett, the discoverer of recalescence, found that manganese-steel gave no "after-glow," and no magnetic tick or sound was

heard, as when magnetizing and de-magnetizing iron, nickel or cobalt. Nickel he found to lose its magnetic properties at 330° C; iron is now well known to do so at about 750° C.

Electrical Resistance.—In America, where so much attention is paid to electrical developments, there should be a considerable use of manganese-steel for resistance-work.

Professor Barrett, Dr. Fleming, Mr. Mordey, of the Brush company, London, Dr. Hicks and others, have made careful tests of the electrical resistance of this steel, the results of which are summed up in the following table.

TABLE XIX.

Material.	Experimenter.	Microhms per cubic centimetre.	Temperature co-efficient in degrees centigrade.
Manganese-steel	Fleming	68·00	.....
" "	Barrett	75·00	·136
" "	Hicks	65·30	·129 ·127
Iron	Barrett	9·80	·40
German silver	"	21·17	·01
Nickel	"	14·10	·40
		Copper unity.	
Copper	Mordey	1	·23
Soft iron	"	5	·69
Brass	"	6	·40
German silver	"	8·80	·08
Platinoid	"	20·00	.....
Arsenical copper	"	27·00	.03
Manganese-steel, according to percentage of manganese		37·00 to 48·00	·136 (Barrett) ·10 (Willans)

The well known firm of English electrical engineers, Messrs. Willans & Robinson, of Thames Ditton, have used 1½ tons of the manganese-steel for resistance-coils in connection with a special electric installation.

THERMAL AND ELECTRICAL CONDUCTIVITY AND SPECIFIC HEAT OF MANGANESE-STEEL.

A paper on these interesting questions was read by Dr. A. Crichton Mitchell, before the Royal Society of Edinburgh on April 1st and July 1st, 1889, and as the scientific results obtained there have great practical bearing and do not appear to have been mentioned in the technical papers, details may be of service here.

It has been found that manganese-steel requires very careful heat-treatment. In heating, ingots are very liable to crack unless most slowly and gradually warmed. In several ways this steel shows itself to be a bad conductor of heat.

This difficulty is clearly indicated by Dr. Mitchell's experiments, which confirm the correctness of practical observations on this point. In order to carry out his experiments he had to prepare finished bars of considerable lengths. Owing to the hardness of the steel it may be readily imagined that this was not an easy matter, much skill and patience being necessary. The object was at last accomplished by grinding and drilling. The bars were 50½ inches and 20 inches long, respectively, each being 1⅓ inches square. In the bar for the former experiments eight holes were drilled for the insertion of carefully standardized thermometers, the first being 9 inches from one end, the others 12, 15, 18, 20, 24, 30 and 42 inches respectively from the same end. The holes were 1⅛ inches deep and 17-64 inch in diameter. One hole of the same size as the above was drilled in the shorter bar, which was fitted with screw-eyes at the ends with which to support it on bearings while being heated. Both bars were finally nickel-plated.

The method of finding the conductivity was substantially that originally devised by Forbes, the only difference being that a shorter bar was used, and the cooling-bath was placed either at its cooler end or near its middle on the cooler side of the fifth thermometer. Full details of the exact methods adopted will be found in Professor Tait's paper on "Thermal and Electric Conductivity" (Transactions Royal Society Edinburgh, Vol. 28), and Dr. Crichton Mitchell's paper "On the Thermal Conductivity of Iron, Copper and German Silver" (Transactions Royal Society Edinburgh, Vol. 28).

Of the eight holes drilled only five were used, viz., the first four separated by intervals of 3 inches, and the fourth and fifth by one of 6 inches. The cooling-bath, through which a stream of water was kept steadily passing, was placed close to the fifth hole.

The method of finding the conductivity, and the manner in which the readings of the thermometers were reduced, and from them the curve of stationary temperature excess constructed, are described in Dr. Mitchell's paper above mentioned.

The final results showed that the thermometric conductivity of manganese-steel is represented by the following numbers:

(1) From areas uncorrected for change in specific heat

0°	100°	200°
·00211	·00216	·00281

(2) From areas corrected for change in specific heat.

·00219	·00272	·00325

For comparison between manganese-steel and a wrought-iron bar Dr. Mitchell states the following figures:

	0°	100°	200°
Mang. steel	·00219	·00272	·00325
Iron	·0019	·01274	01358

Thus it appears that manganese-steel at 100° is lowered to one-fifth, and the rate of increase of conductivity with temperature is in manganese-steel little more than half the corresponding coefficient of iron. It can be easily understood why manganese-steel pokers used by several friends of the writer have been prized so highly.

Owing to the high electrical resistance of manganese-steel, it might naturally have been expected that this low conductivity would follow, again confirming the similar qualities and effects of currents of heat and currents of electrical energy.

The specific-heat determinations were made with 1⅜-inch cubes of wrought-iron and manganese-steel respectively.

Each was raised to a temperature of 300° C., and then, by means of a thermometer inserted in a mercury-filled hole previously drilled in each cube, the rates of cooling were carefully deduced. The specific heat of the iron cube was found to be 0·114, agreeing with previous experimenters, and that of the manganese-steel 0·124, or 1·087 times that of iron. Its rate of rise with temperature was the same as that of the iron.

Electrical Conductivity.—Professor Barrett and M. H. le Chatelier have made a careful series of experiments with this steel with respect to its expansion in wires 19 B. W. G. (0·96 mm. diameter) at temperatures from 0° C. to 100° C. The results showed the following coefficients:

TABLE XX.

Coefficients of Expansion.

Manganese-steel, Barrett	·000015	1° to 100° C.
Ordinary " "	·000117	
Manganese " Le Chatelier	·000245	1° to 1,000° C.
Ordinary " "	·000015	

Contraction of Manganese-Steel.—In view of the very exact records of Dr. Mitchell and others, it is easy to understand that the contraction of manganese-steel from the fluid state must be serious, and that, if the care and ingenuity of the steel-founder are necessary to avoid contraction-cracks in ordinary steel, this is still more the case with manganese-steel.

The following comparisons of contraction were made at the Hadfield Steel Foundry Company's works. Bars 2 inches square, with flanges, and projecting at each end about 12¼ inches between the latter, were cast of various qualities of steel, the results being as follows:

TABLE XXI.

Material.	Distance between flanges. Before casting. Inches.	After casting. Inches.	Contraction on 12 inches.	Contraction per cent.
Medium cast-steel, 50% C.	12·256	12·0215	·2345	1·91
Medium 60% C.	12·256	11·9826	·2734	2 23
Manganese steel as cast	12·256	11·8026	·454	3·60
" " water quenched	12·256	11·9045	·3515	2 80

The cast manganese-steel therefore showed the high rate of 3·60 per cent. contraction against about 2·00 per cent. for carbon cast-steel. The usual pattern allowance by steel-founders is ¼ to 5-16 inch per foot, or about 2 per cent. (which the above table confirms) so that manganese-steel is considerably higher. But the curious point is that, after water-toughening, the manganese-steel has expanded considerably in the sample. The details of this test may not be exactly accurate, as it is possible the bar may have become bent during the heating for the water-quenching process. Still there is clear evidence that comparatively a considerable change has occurred under this treatment. This has been borne out by some independent tests relating to specific gravity made for the writer by Mr. David Kirkaldy, of the Testing Laboratory, London.

Specific Gravity.—He found that manganese-steel varied in its specific gravity according to the state in which it existed.

TABLE XXII.

Experimenter.	Material.	Specific Gravity
Kirkaldy.	Manganese steel as forged.	7·8674
"	" air toughened or annealed.	7·8630
"	" water toughened.	7·8615
Barrett.	" wire, 19 B. W. G.	7·81
Hadfield.	"	7·863
Arnold.	Pure iron (99·8% Fe.)	7·8630

This being an interesting point, it may be well to give Mr. Metcalf's results of very carefully taken specific gravities of carbon-steel of various percentages and quenched at different heats. Four samples only are selected; but full details of 12 tests will be found in Mr. Metcalf's admirable contribution to the discussion on Mr. Cunningham's paper, "Hardening Structural Steel," read before the American Society of Civil Engineers, June 10th, 1892.

TABLE XXIII.

Sample No.	Carbon per cent.	Spec. grav. of ingots.	Rolled bar.	Bar quenched black hot.	Bar quenched at scintillating heat.
3	·52	7·841	7·844	7·831	7·818
6	·84	7·824	7·829	7·812	7 7·9
10	1·00	7·807	7·826	7·812	7·744
Arnold's pure iron, 99·8% Fe.	·07	.....	7.863	.....	....

The difference between the rolled and the water-quenched bars of carbon-steel (Table XXIII.) is considerable. In the manganese-steel, Table XXII., the difference is much smaller, but still sufficient to be detected. If worked out on cubes weighing, say, a ton, and the difference in size allowed for expansion between forged and forged-water-quenched, the weight would not be altered more than two pounds.

Hardness.—As it is very important when comparing hardness to have some more exact standard than filing or chipping, the writer appends a table which may be of service. Most of the tests have been made

TABLE XXIV.

Description of sample.	Mark.	Condition.	Analysis. C.	Si	Mn.	Al.	Cr.	Scale of hardness by Turner's sclerometer.
Manganese-steel	783	As forged	·74	·50	12·03		....	61
"	931	"	·55	39	7·10	...	..	80
Silicon-steel	A	"	·14	·24	·14	....	..	20
"	B	"	·18	·79	·21	....	....	20
"	E	"	·20	2·67	·25	....	....	25
"	G	"	·25	4·49	·36	....	....	33
Aluminum-steel	1,167	"	·22	·09	·07	·15	....	20
"	1,167 D	"	·17	·10	·18	·72	....	20
"	1,167 H	"	·24	·18	·32	·21	...	20
Chromium-steel	1,176 A	"	·07	·07	·11		·22	22
"	1,176 E	"	·12	·08	·18	....	·84	24
"	1,176 H	"	·39	·14	·25	....	2 54	24
"	1,176 J	"	·77	·50	·61	....	5·44	43
Lead								1
Copper								8
Rolled platinum								14
Softest iron								15
Mild steel								21
Good razor steel								60
American chilled car wheel								66
Very hard white iron								72

by Professor Turner, of the Mason College, Birmingham, with his sclerometer, an apparatus which has also been used with satisfactory results in America by Mr. W. J. Keep, of Detroit.

MINERAL PRODUCTION OF GREAT BRITAIN.

The mineral production of the United Kingdom of Great Britain and Ireland for the year 1892 is given below from the official statement. The production is reduced to metric tons (of 2,204 lbs.), and comparison is made with the statements for 1891 given in the tables of the "Mineral Industry." The full tables in that work include 32 years, 1860–1891 inclusive:

	1892.	1891.		1892.	1891.
Alum shale	2,969	5,564	Iron pyrites	14,193	15,716
Arsenic	5,197	6,147	Lead ore	40,678	44,578
Arsenical pyrites	4,570	5,179	Manganese ore	6,177	9,632
Barytes	24,643	27,317	Ochre and umber	12,329	13,825
Bauxite	7,442	10,939	Oil shale	2,623,167	2,399,526
Clays	3,154,550	3,274,855	Phosphate of lime	12,399	10,164
Coal	184,751,629	188,519,767	Salt	1,988,482	2,077,072
Copper ore	6,093	8,981	Slates and slabs	424,619	421,829
Copper precipitate	274	327	Sulphate of strontia	5,149	8,193
Fluor-spar	174	143	Tin ore (black tin)	14,563	14,726
Gold ore	10,153	14,348	Wolfram	127	140
Gypsum	149,858	154,195	Zinc ore	27,319	22,580
Iron ore	11,497 456	12,987,159			

It will be seen that, with the exception of salt, zinc ore and a few minor minerals, last year showed generallly a considerable falling off in production.

THE STILWELL-BIERCE & SMITH-VAILE EXHIBIT AT CHICAGO.

Among the most interesting and instructive exhibits in Machinery Hall, at the World's Columbian Exposition, Chicago, is that made by The Stilwell-Bierce & Smith-Vaile Company, of Dayton, O. It embraces Victor turbines of both "register gate" and "cylinder gate" patterns, arranged on both vertical and horizontal shafts, and ought not to be overlooked by any who are using or contemplating the use of water power. These turbines are built in such a great variety of styles and sizes as to meet the requirements of almost any situation. Other interesting features of the exhibit are the Stilwell "open" and "close" heaters and the live steam purifier for heating and purifying feed-water for steam boilers. The practical efficiency of these heaters is demonstrated by a display of lime deposits taken from heaters in operation in various sections of country. The proper treatment of feed-water is an item of great moment in designing an economical steam power plant, and should be carefully investigated. This exhibit also contains a display of Smith-Vaile steam pumps in great variety of styles and for every duty, thus increasing the practical value of the exhibit to all visitors who are making investigations along these lines.

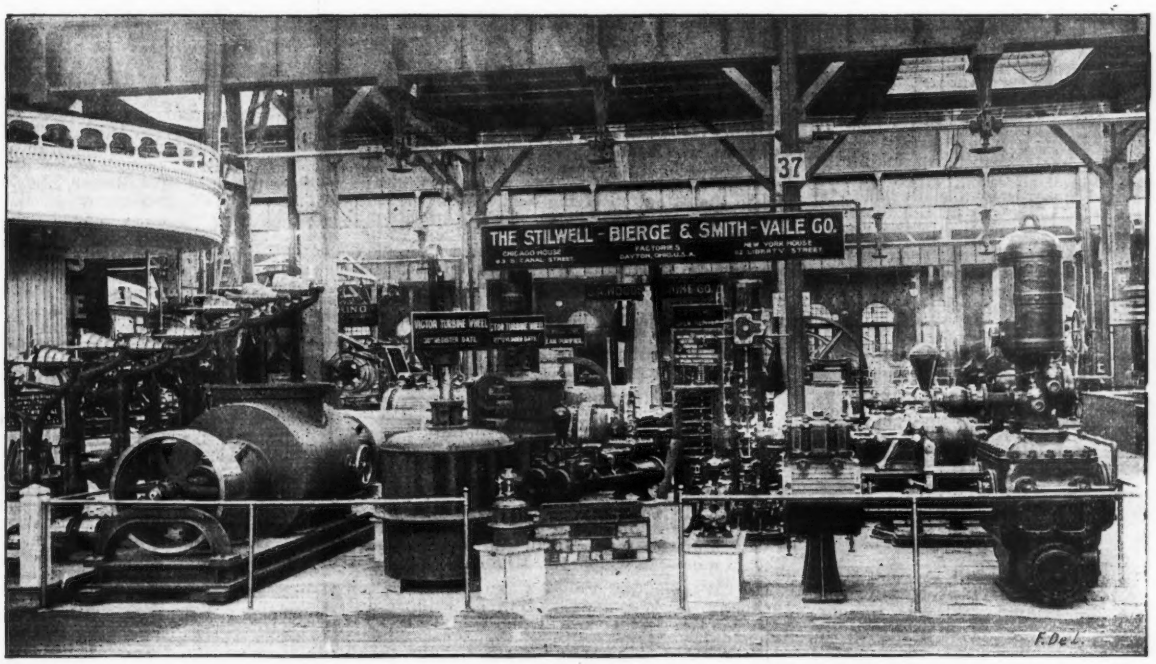


EXHIBIT OF THE STILLWELL-BIERCE & SMITH VAILE COMPANY AT CHICAGO.

The Geological Survey of India.—A recent resolution of the Government of India requires that two-thirds of the survey officers shall always be primarily engaged on the explorations necessary to complete the geological survey and the remaining third on the practical investigation of mineral fields. In the latter case the exploration will be confined to such preliminary examination as may be necessary to supply general information regarding their character and extent to capitalists and promoters upon whom will rest the responsibility for more detailed prospecting. The work of the past year was of the most varied character. The most important scientific operation of the year was that carried out in the Central Himalayas by two of the survey officers in co-operation with Dr. Diener, an eminent specialist sent out from Vienna, and their joint researches are said to be of high scientific interest. There were experimental borings for oil in Beloochistan and on the Indus, investigations into the Nerbudda coal fields, the coal resources of Tenasserim, jade in Burmah, coal and rubies in the regions bordering out Yunnan, and much else of a similar character.

RECENT DECISIONS AFFECTING THE MINING INDUSTRY.

Supreme Court of Iowa.

Lease of Coal Land.

A lease of land to a mining company, in consideration of the payment to the lessor of a specified royalty on merchantable coal to be taken out of such land, required the lessee to conduct thereon the principal mining business in the county, and take from such land a majority in bushels of all the coal mined by it in such county each year, except that the amount need not exceed 200,000 tons per annum. The lease was to continue until the lessee should remove all the available merchantable, and salable coal on the land. On performance by the lessee, and on condition that it shall have taken out all the available coal from such land, as contemplated, it was entitled to certain specified rights. The chief purpose of the lease was the mining of all available coal on the land, and the payment to the lessor of the specified royalty. At the time such lease was executed, both the lessee and lessor believed that there was sufficient available merchantable coal on the land to enable the latter to take therefrom the amount required by such lease, but, in a few years it transpired that the lessee could not take more than one-half of all the coal mined by it in such county without reducing the output from other land. Where the lessee had mined all the available coal, and the lessor had received royalty on all the merchantable coal mined, the latter was not entitled to royalty on the difference between the amount actually mined and the amount required by the contract to be mined. Where, by the terms of such lease, the lessee has no right to surrender the premises until the available coal is exhausted, it is not required to surrender it to entitle them to exemption from payment of royalty on coal not mined therefrom.—(Carr versus Whitebreast Fuel Company. 55 N. W. Rep., 205.

Smokeless Powder.—The Navy Department recently manufactured at the powder works at Newport, R. I., two varieties of smokeless powder. The base of both of these powders was pure gun cotton, which is turned into celluloid, and then reduced to grains, but they were differently treated in preparation. On May 26th they were subjected to tests at the proving ground at Indian Head to demonstrate the exact effect of the different treatments. A 6-in. gun was used for the tests, although the powder was really intended for 8-in. calibers. The trial shots showed that the different methods of preparation of the same material produced very different results, as one of the powders gave to the shot a velocity of 2,000 ft. per second, with a pressure in the chamber of 11 tons, while the other showed a velocity of 2,250 ft., with a pressure of 16 tons.

PATENTS PUBLISHED IN GREAT BRITAIN.

The following is a list of patents published by the British Patent Office on subjects connected with mining and metallurgy:

WEEK ENDING JULY 15TH, 1893.

11,537 of 1892. Sand Shifting Machine for Foundry Purposes. J. P. Hall and T Glover, London.
13,316 of 1892. Production of a Ferric Chloride Preparation for Use in Treating Sewage. Dr. C. A. Burghardt, Manchester.
14,579 of 1892. Bronze Alloy, Composed of Copper, Ferromanganese, Nickel and Zinc. Prof. A. K. Huntington and R. T Preston, London.
14,982 of 1892. Utilizing Blast Furnace Slag. T. D Rock, London.
15,083 of 1892. Manufacture of Pure Aluminum Fluoride. L Grabau, Halle, Germany.
15,255 of 1892. Production of a Ferric Preparation for Use in Treating Sewage. Dr. C. A. Burghardt, Manchester.
8,932 of 1893. Miners' Safety Lamps. F. Gothot, Mulheim, and A. Hoing, Altendorf, Germany.
10,189 of 1893. New Phosphate Manure. J. Schmitt, Bubenheim, Germany.

PERSONALS.

Mr. E. S. Moffat, president of the Lackawanna Iron and Steel Company, of Scranton, Pa., has gone to Europe for his health.

Mr. Fred J. Manley has been appointed steam boiler inspector for Allegheny County, Pa. This includes Pittsburg, Allegheny and surrounding territory.

Mr. R. A. Hadfield, of Sheffield, England, arrived in New York July 28th, on the "Campania," on his way to attend the engineering congress in Chicago.

F. E. Bachman, formerly manager of the Salem Furnace Company, of Salem, Va., is now superintendent of the Buffalo Furnace Company, of Buffalo, N. Y.

Dr. Herman Wedding, of Berlin, the eminent metallurgist, has been appointed one of the judges at the World's Fair. He sailed on the "Havel" for New York on July 18th.

Mr. Julian Kennedy, the mechanical engineer of Pittsburg, has been chosen to prepare plans and superintend the construction of the new water works to be built in Allegheny, Pa.

Mr. C. W. Gibbs, recently assistant engineer on the Rio Grande Southern Railroad, has resigned and has opened an office in Durango, Colo., for general and mining engineering work.

Mr. Walter Renton Ingalls, mining engineer, has returned from Europe, where he has been for the past four months. He may be addressed temporarily in care of the "Engineering and Mining Journal."

Mr. C. C. Morgan, formerly manager of the British Broken Hill Proprietary Company, has severed his connection with it, and the mines are temporarily under the charge of Mr. Retallick, the former underground manager.

Prof. H. H. White has resigned, because of ill health, the chair of mathematics, which he has occupied for nearly a quarter of a century in the Kentucky University. He is one of the most famous educators and mathematicians in the South.

Mr. Wilbur C. Knight, mining engineer, has resigned his position as superintendent of the Otras Mining Company, Limited, of Laramie, Wyo., and has accepted the chair of mining and metallurgy in the University of Wyoming, at Laramie. The University is to be congratulated on securing the services of a professor with extended practical experience to supplement his theoretical training.

Mr. D. N. Coffin has resigned his position as superintendent of the W. Y. O. D. mine in Grass Valley, Cal., to give all of his time to developing the resources of the Green Mountain mine, in which he is largely interested. Mr. W. H. Shockley has been appointed to succeed him as superintendent of the W. Y. O. D. For over twelve years Mr. Shockley has been superintendent of the Mt. Diablo mine, Candelaria, Nev., which is now closed down.

Mr. Thomas Rowe, who has had charge of the Philadelphia & Idaho Company's concentrating plant, at East Fork, Triumph, Alturas County, Idaho, for a number of years and in that capacity became affected by lead poisoning, is again almost well under medical advice, has had to refuse the charge of mills crushing similar ores at least for a time. Mr. Rowe has had a large experience in copper concentration, and will probably move to a copper district.

The Jury on Mines and Mining, at the World's Columbian Exhibition at Chicago, completed its organization on July 26th and has made substantial progress in judging exhibits. Its officers are: President, Mr. Henry M. Howe, of Boston; vice-presidents, Messrs. de Zellenkoff, of Russia, and Lundbohm, of Stockholm; secretary, Mr. J. D. Weeks, of Pittsburg. Among the prominent names on this jury are those of Professors LeNeve Foster and Bauerman, of the Royal School of Mines, London; Signor Capacci, of Florence, Italy; Mr. Odelstjerna, of Sweden; Professor White, of the University of West Virginia, and Maj. Jed. Hotchkiss.

OBITUARY.

John Rollins Smith, who died in Springfield, Mass., last week, aged 54 years, was a civil engineer, and had devoted much of his time to bridge building. He was treasurer of the Springfield Iron Works.

Ambrose Powning, who died at Grass Valley, Cal., July 15th, aged 64 years, was one of the pioneers of the district, having gone to California in 1854. He had lived in Nevada County for 30 years. He was a native of Cornwall, in England.

Werner Kummel, one of the best known engineers in Germany, died at Oakland Hotel, Chicago, July 19th, aged about 69 years. Mr. Kummel had been in America about three weeks and in Chicago about one week. He came here to visit the World's Fair and the congress of engineers. During the very warm weather after his arrival in Chicago he was overcome by the heat and died after a few days' illness. Mr. Kummel was the leading engineer on the water works in Germany. Since he had been in America he had been in Boston, New York and Philadelphia, where he was consulted by a number of American engineers interested in water and gas engineering. He had prepared two papers which he was to have read before the engineers' congress in connection with the World's Congress Auxiliary.

SOCIETIES AND TECHNICAL SCHOOLS

Scandinavian Engineering Society of Chicago.—At the annual meeting and accounting the following officers were chosen: E. Lee Heidenreich, president; I. G. Giaver, first vice-president; E. Moyel, second vice-president; Allan Strale, secretary; N. A. Christensen, recorder; Karl L. Lehmann, treasurer; Alb. Ackander, librarian.

A reunion of Scandinavian engineers will be held in the Art Palace (lake front), in Chicago, in the week when the Engineering Congress is in session. It will be under the auspices of this Society, and further information will soon be given.

International Irrigation Congress.—The Secretary of State has issued a circular to the diplomatic representatives of the United States, instructing each to informally notify the Government to which he is accredited, of this meeting of the International Irrigation Congress, which is to convene at Los Angeles, Cal., October 10th, 1893, and requests its co-operation through duly accredited delegates. The Department of the Interior will be represented at the proposed meeting by an officer to be detailed by the secretary of that department, for the purpose of giving such information as may be desired concerning the results obtained by the surveys which have been carried on for several years under the auspices of the General Government.

American Chemical Society.—The committee to co-operate with the World's Fair Auxiliary have determined that the Fifth General Meeting of the Society shall be held during a period beginning August 21st, 1893, in conjunction with the World's Congress of Chemists, to be held under the auspices of the World's Fair Auxiliary and the American Chemical Society. The committee desire to call to the attention of the members of the Society and of American chemists generally the fact that in view of the large number of emininent chamists, home and foreign, who have already signified an intention to attend the World's Congress of Chemists, and the valuable character of the papers that will be presented, this meeting will doubtless be the most important gathering ever held by chemists in the United States. The time and place are therefore particularly auspicious.

INDUSTRIAL NOTES

The Harrisburg (Pa.) Foundry and Machine Company has booked orders for a 225-H. P. engine for New York city, and a 30-H. P. engine for the Washington Navy Yard.

Mr. P. L. Kimberly has leased the Sharon furnace of Boyce, Rawle & Co., at Sharon, Pa. It is said that the furnace will run on ore from the Mesabi mines, in which Mr. Kimberly is interested.

The Washington Foundry and Manufacturing Company, of Washington, Ga., is winding up its affairs. The business will be continued by the Washington Manufacturing Company, composed of G. E. Lyndon, A. M. Adams and W. T. Johnson.

The Keuffel & Esser Company, New York, has issued a new catalogue, describing several improved surveying instruments, including transits and levels of different patterns, plane-tables, rods, tapes and special mining rods. The catalogue is well illustrated.

The Stirling Company is apparently not affected by dullness of business, having lately closed orders for 750-H. P. water tube boilers for the Minneapolis Electric Company, 750 H. P. for the J. H. Mattingly Company, Louisville, Ky., and 150 H. P. for the Taylor Chair Company, Bedford, O.

The Cortland Forging Company, Cortland, N. Y., has broken ground for the erection of three new buildings adjoining those now occupied by the company, one to be 48×100 ft., one 30×36 and one 40×18 ft. The buildings will be two stories high and constructed of wood. The intention is to double the capacity of the works.

The Otis Steel Company, Limited, of Cleveland, O., composed principally of English stockholders, have notified their employees of a reduction in wages varying from 10 to 20%, which went into effect on Monday, July 17th. It is claimed by the firm that heretofore they have been paying wages higher than is paid by Pittsburg competitors.

At the annual meeting of the stockholders of the Sterling Steel Company, of Pittsburg, the following were chosen directors: C. Y. Wheeler, John M. Hughes, C. W. Mackey, J. W. Rowland and S. Beymer. The board elected the following: President, C. Y. Wheeler; vice-president, C. W. Mackey; secretary, John S. Lyon; treasurer, A. S. Beymer.

The firm of Forsyth, Hyde & Co., Chicago, which controls several furnaces, has made an assignment, and two of the controlled companies have taken the same action—the Wellston Furnace Company, Wellston, O., and the Wisconsin Furnace Company, Fond du Lac, Wis. The assets in all three cases are said to exceed the liabilities, if proper time for collections is allowed.

A contract has just been closed by the Southern Engineering Company, of Louisville, Ky., for the erection of a steam plant at Portsmouth, O., for the Portsmouth Street Railroad and Light Company. It will include two 125-H. P. horizontal tubular steel boilers and two 125-H. P. Ball & Wood automatic engines, together with the necessary steam pumps, heaters, etc.

The Carnegie Steel Company, Limited, has placed an order with the Yale & Towne Manufacturing Company, Stamford, Conn., for eleven 10-ton electric traveling cranes. These cranes are to be used at the Homestead Steel Works, in taking beams from the cooling tables and distributing and loading them on cars ready for shipment. They will be used out of doors, unprotected from the weather.

Recent orders received by the Philadelphia Engineering Works, Limited, are one 18×36 special Corliss engine for the Pennsylvania Railroad Company; one 22×48 Philadelphia Corliss for the Delaware County Construction Company, Clifton Heights, Pa.; one 12×30 Philadelphia Corliss for Harrisburg, Pa., and one 26×50×54 cross compound condensing engine for the Pennsylvania General Electric Company.

The Court street bridge, Rochester, N. Y., is being built with two Lidgerwood cableways placed side by side. The plant is attracting a great deal of attention. Messrs Lauer & Hagaman are the contractors. The Lidgerwood Manufacturing Company has in press and will shortly issue a new pamphlet bearing the title, "Cableway Sketches." It will contain about 60 pages and will be be the fifth of their well known series of sketchbooks.

The annual meeting of the stockholders of the Ohio Steel Company, now building a Bessemer plant at Youngstown, O., was held in that city last week. The directory board was increased from seven to eight, as follows: Henry Wick, J. G. Butler, Jr., Myron Wick, E. L. Ford, E. L. Brown, J. L. Botsford, L. E. Cochran and James Parmlee. The directors organized by electing Henry Wick president; J. G. Butler, Jr., vice-president, and Myron Wick, treasurer.

We are informed that the appeal of the Cowles Electric Smelting and Aluminum Company from the injunction granted by Judge Taft, was withdrawn simply because counsel considered it the wisest course not to bring the case before the appellate court until a final hearing has been had and the whole case brought before the court. No final decision has been given in any form, and the case is still open. Meantime, the Cowles company is making alloys and handling pure aluminum from Europe.

The Pittsburg Testing Laboratory was reorganized July 1st, and is now owned by a limited partnership, under the title of Pittsburg Testing Laboratory, Limited. Some of the old employees have been admitted to the new company, in addition to the former proprietors, Messrs. Alfred E. Hunt and George H. Clapp. The officers are as follows: G. H. Clapp, chairman; Alfred E. Hunt, vice-chairman and treasurer; J. M. Bailey, secretary; A. B. Bellows, general manager, and L. S. McKeever, assistant treasurer.

The American Steel Wheel Company, New York, issue a circular under date of July 17th, to the stockholders and creditors of the company, announcing that upon the application of a majority of the stockholders and of more than two-thirds of the creditors, John C. Paul, president of the company, was appointed their receiver by the Chancellor of the State of New Jersey. The stockholders and creditors who joined in this application include, among others, George H. Burt, J. Rogers Maxwell, the Liberty National Bank, the Pond Machine Tool Company, the Garwood Land and Improvement Company, and the Central Railroad Company of New Jersey.

An important decision was filed recently in Milwaukee by Judge Seamans, of United States Circuit Court, for the District of Wisconsin, in the suit brought by the Edison General Electric Company against the Electric Manufacturing Company of Oconto, Wis., upon the well known Edison incandescent lamp patent. The suit was brought against the Oconto company for infringement of the Edison patent by manufacturing and selling incandescent electric lamps, and the decision filed grants an injunction restraining defendant from any further manufacture and sale of such lamps. This decision of Judge Seamans is in line with the decisions of Judges Wallace, Shipman and Lacombe, of the Second Circuit, and of Judge Colt, of the Massachusetts Circuit, and its significance and importance is in the fact that the validity of the Edison patent was attacked by the defendant through what has become known as the Goebel anticipation. The issue of the injunction is practically a finding by the court against the Goebel defense. The augument of the motion consumed an entire week at Milwaukee.

MACHINERY AND SUPPLIES WANTED.

If any one wanting machinery or supplies of any kind will notify the "Engineering and Mining Journal" of what he needs he will be put in communication with the best manufacturers of the same.

We also offer our services to foreign correspondents who desire to purchase American goods, and shall be

pleased to furnish them information concerning goods of any kind, and forward them catalogues and discounts of manufacturers in each line.

All these services are rendered gratuitously in the interest of our subscribers and advertisers; the proprietors of the "Engineering and Mining Journal" are not brokers or exporters, nor have they any pecuniary interest in buying or selling goods of any kind.

GENERAL MINING NEWS.

ALABAMA.

Cleburne County.

(From our Special Correspondent.)

At the Wise property, about four miles northwest from the Lucky Joe, work has been suspended for the present. Mr. Turner, the holder of the option, after working for several months in a successful attempt to develop the ore body and enable him to show its extent, which demonstrates that it is the largest ore body in sight in the district, is awaiting the completion of negotiations for the erection of a 40-stamp mill.

At Pinetuckey active operations are being carried on, with good results from concentration, by the Huseman process. Work has been dragging here somewhat because of the method of mining and the limited pump capacity, but it is purposed to finish sinking the millhouse shaft at once, and in future to mine in a systematic manner, and abandon the old workings entirely. Under the old system of working, the hanging wall has been mined, and the vein itself at the bottom of the wall is now under water for a great distance in the drift. This vein, although quite narrow, averaging some 15 in., is very rich and carries free gold specimens, but its chief value is in the sulphurets.

A limited number of prospectors are working in different portions of this district, and reported finds of more or less richness and extent are frequently heard of. At one of these, known as the Sutherland property, a wooden mill, furnished with wooden stem, tappits, canes, boxhead, shoe and die, with an old iron mortar, is being erected. The Crown Point mine, where a five-stamp mill was put up to run on a low-grade ore, is shut down.

Work of sinking at the Eckles property is being continued, the shaft having been sunk 15 ft. deeper, showing that the change from the soft material at the surface which was changing to harder at the 40-ft. level, is becoming more marked as depth increases, and the value of the ore is also increasing. A mill test of about one ton and a half of surface dirt at Pinetuckey resulted in saving six dwt. of gold, but the material was too soft and the drop not right to mill satisfactorily.

CALIFORNIA.

Butte County.

(From our Special Correspondent.)

The most extensive and costly quartz developments are being made at Forbestown. The mines in the vicinity were worked at one time and then abandoned, as the rock contained sulphurets to such an extent that the ore could not be worked profitably with the processes then in vogue. Alvinza Hayward and W. W. Stow reopened them a few years ago, and extensive work had been done during the past two years. The former has a 40-stamp mill. It is claimed that there is enough ore in sight at present to last for 10 years, and the ore is paying so well that the mill will be enlarged by the addition of 20 stamps. The machinery is run by water power and the mine and mill lighted by electricity.

At Merrimac mills the Palo Alto Company is engaged in setting up a large new engine and boiler for running the 20-stamp mill, and will put in 10 additional stamps.

Bonner Mine, Oroville.—Frank McLoughlin is sinking on this famous mine, which at one time was one of the richest ledges in the State, and is believed to contain rich quartz below where work ceased.

Calaveras County.

(From our Special Correspondent.)

Calaveras Consolidated Mining Company, Angel's Camp.—The mine has started up with a large force of men, after being closed down for more than a year. The property is owned by an English syndicate.

Kern County.

(From our Special Correspondent.)

Arrangements are being completed by which the Blue system of mines, near Kernville, will again be worked. The company which bought the Mammoth mine, at Keysville, has put a force of men at work.

Nevada County.

Brunswick Consolidated Gold Mining Company.—The Superintendent reports under date of July 19th: Since my last letter the 700-ft. drift has been extended 5 ft.; ground is very hard. Ledge is 18 in. wide, and shows well in free gold and sulphurets. In the 700-ft. upraise the ledge is from 6 to 10 in. wide, showing a little mineral and some fine gold, and from the appearance of the country rock I think we will soon have as good a ledge as in the drift. The raise is up 22 ft.

Victor Mining Company.—The superintendent reports that 60 tons of ore so far in July have averaged $315 gold per ton.

Shasta County.

Sierra Buttes Gold Mining Company, Limited.—The output and work during June was as follows: Sierra Buttes mine, total receipts, $2,478; total working expenses, $1,349; Plumas Eureka mine, total receipts, $10,490; total working expenses, $8,540. Uncle Sam mine, total receipts, $16,254; total working expenses, $7,548.

Siskiyou County.

(From our Special Correspondent.)

In this section there is no hindrance to hydraulic mining, the Klamath River, the main stream which receives the débris of the mines, having been declared by enactment of the California Legislature non-navigable. This season has proved an unusually good one, the summer so far having been less hot than usual, causing the slow melting of the snow on the mountains and the conservation of the water. Around Etna and Quartz Valley and along the river the clean-ups will be good. A wagon road has just been completed to the Salmon River from Etna. This section would receive an impetus should fresh capital be invested in the mines of California.

COLORADO.

Boulder County.

Springdale Gold Mining and Milling Company.—As is mentioned in our issue of July 8th, a number of shares of this company are being offered on the London market. The property has been reported upon by Mr. W. M. Rule, of Denver, Colo., who is indorsed by Mr. Wm. B. Root, president of the Mining Colorado Stock Exchange. Mr. Rule, after descanting on the situation for the facilities for wood, water, coal, vicinity to a summer resort and the romantic history of the district, states that the Rip Van Dam mine, one of the leading properties, belonging to this company, has been famous, owing to the richness of its telluride ore. Mill runs, state Mr. Rule, have yielded as high as 545 oz. gold and 1,650 oz. silver, yielding $12,700 a ton, and that one assay yielded at the rate of $106,000 per ton. Right after this Mr. Rule states that the output of this property has been about $15,000 only. It is a foregone conclusion that very little $106,000-ore would make this amount, or not more than a ton and a quarter of $12,000-ore would be required. Now, this mine, according to Mr. Rule, has been developed by a shaft 91 ft. deep, with levels driven at 40 ft. and 75 ft. This is not extensive development work, but it is sufficient, unless the ore is extremely pockety, to have produced considrably more than a few tons to concede a maximum amount. Either one of the two things is sure, the ore is of a much lower rate than Mr. Rule would have us infer from his statement regarding his "mill runs," or the pay streak is extremely irregular, and as narrow as a knife blade. Among the advantages which Mr. Rule claims of this property is the fact that it is merely a prospect, and that it is virgin. These advantages are somewhat doubtful, since without a showing of ore in sight it is more or less like buying a pig in a poke, but we are quite willing to give Mr. Rule full credit for having discerned this peculiar advantage. We cannot concur with Mr. Rule in his statement that this property with its present showing is a safe investment; on the contrary, we think that the property should be examined by some engineer who will not overlook nor neglect the main points of an examination.

Clear Creek County.

Colorado Central Consolidated Mining Company.—This company has been compelled to shut down. The mine has been left in working order, so that work can be resumed when the demand for silver justifies resumption. The officers of the company are understood to be strongly in favor of the unconditional repeal of the Sherman law. The majority of shares of this company are held in Holland.

Lake County.

(From our Special Correspondent.)

Word has been received here to make preparations pulling the pumps in the Mammoth, Maid and Henriett consolidation. This means, if done, the total abandonment of the mines. The effect of raising of water on the adjacent mines will unquestionably be very serious, and may result in the enforced abandonment of other property. The big Maid property is connected by drifts with the Wolftone, the Adams and the Mahala, which will, if the pumps are pulled, fill rapidly with water. The Small Hopes, the Emmett and other properties, although not directly connected, will have a heavy increase of water and will need additional pumping facilities. The main shaft of the Maid is down 960 ft., and it is expected that the water will rise to within 300 ft. of the surface.

After a conference between E. R. Holden, of the Holden Smelting and Refining Company, and his creditors lasting over two days, a satisfactory agreement has finally been entered into. The attachments have been withdrawn and the smelter is to run under the supervision of Mr. Holden and a committee appointed by the creditors. The principal source of the value of the new management is the slag, of which there is 750,000 tons on hand, which can be smelted by the Holden process to a profit. It is believed the smelter will start up before the close of the present month.

On Breece Hill the ore is largely of an auriferous character, and there is some mining carried on in that section. Good streaks of lead ore are also encountered, which are just now marketable commodities.

On the Little Johnnie a new plant of machinery is now being placed in position and a new shaft is being sunk. Near here the Eliza has just encountered some streaks of excellent lead ore. In addition to these the Fanny Rawlings, Black Prince and other leases in this same neighborhood are now shipping on an average 100 tons daily.

The Star of Hope property has entirely closed down. The pumps, while not pulled, have not been working since the first of the week, and the water has already risen 100 ft.

Attachments amounting to $11,898 were filed this week against H. A. W. Tabor and A. V. Baten on the A. V. B., Valentine and Lucy B. Hussy lodes, which were levied upon by the sheriff.

The new concentrating mill of the Silver Cord Combination was set fire by unknown parties and burned to the ground this week, entailing a loss of over $15,000. This mill was completed in 1892 as an important adjunct to the Silver Cord mine, and successfully treated thousands of tons of low-grade concentrating ore that was mined by means of the Mammoth tunnel through the direction of the able manager, A. A. Blow. One hundred tons of this low-grade stuff was treated daily. Why the mill was set on fire is a mystery.

Quite a number of Leadville miners are now turning their attention to placer mining, and the banks of the Arkansas, below the camp, are lined with prospectors panning for gold.

Ouray County.

New Guston Company, Limited.—Output for June month—Ore shipped, 690 tons; ready for shipment (30th June), 30 tons; total, 720 tons. Value (estimated), $19,646. Mine expenses, $16,100.

New Viola Company, Limited.—A proposition is being made for a second reconstruction of this company, under the name of the Pearl Mining Company, Limited, with a capital of £93,750, £75,000 of which will be in £1 shares and £18,750 in 75,000 10% cumulative preference shares of 5s. each. Every member of the existing company is entitled to one fully paid £1 share for every two now held by him, conditionally on his applying for at least one preference share of 5s. for every fully paid share allotted to him. A report on the Pearl and Old Missouri mines, belonging to this company, and which are situated on the Red Mountain mining district, near Silverton, Colo., by Mr. R. W. Hollis, accompanies the prospectus. According to this gentleman there is not a great deal of pay ore in sight. In fact, the most favorable statement he makes is that two streaks of ore in the mine are converging and will, he expects, make a good ore body in from 60 to 100 ft. In a report appended to this Mr. Hollis says that in order to place the Pearl mine on a paying basis, an expenditure of $10,300 must be made. This will allow the sinking of a shaft of 100 ft., and the sinking, raising and drifting of a winze to the extent of 1,000 ft. He concludes: There are now shown in the mine considerable ore bodies, but they cannot be advantageously extracted without doing the above-mentioned work. From the present indications in the lowest workings of the mine, I believe that, in sinking the 110-ft., and prospecting the ground thus made accessible, there will be a decided improvement in the ore. In justice to the mine and to the shareholders, I must say that I know of no properties which would justify an expenditure for further development to a greater degree than the Pearl. The raising of this additional capital will permit of paying the £15,000 of the purchase price of the Pearl and the Missouri mines, should it be desirable to take up the option. We would not think after reading Mr. Hollis' report that the stockholders in this company would benefit more by this proposed reconstruction than they have by the former one.

Pitkin County.

The latest reports from the new Difficult gold districts, some 14 miles southeast of Aspen, are that the ore is found on top of the ground, and runs as high as $40 to the ton. There were only six men in camp during the winter. They are the locators and owners of the New York and Mamie D., and are sacking ore for transportation by burro that will run not less than $40 in gold. Since the shutdown of the silver properties began fully 100 prospectors have visited Difficult with the result that this many claims have been staked out. Difficult Creek heads near Independence Pass and empties into the Roaring Fork. In early days placer mining was carried on quite extensively. At the present time the mines of Independence, owned by R. J. Bolles principally, are not being worked. Difficult district adjoins Independence.

San Miguel County.

(Reported for the "Engineering and Mining Journal.")

Silver Pick.—This mine is the property of the Mt. Wilson Gold and Silver Mining Company, and is situated on the summit of Mt. Wilson, at an elevation of 12,600 ft. above sea level, about 18 miles southwest of Telluride. This Mt. Wilson is a break of eruptive diorite up through the cretaceous sandstone and schist; and the area of eruptive rocks is quite small as compared with the tilted sedimentary formation; but within this area are located the fissure veins, among which the Pick is the largest and most defined. The ore is a sulphide of iron, lead, zinc, copper and antimony, and assays from 2 to 20 oz. gold and 10 to 20 oz. silver per ton, some specimens of telluride running as high as 114 oz. gold per ton. The gangue is

quartz, spar and country rock. At present, with a force of 30 men, it is shipping about 90 tons of ore per month to the Grant smelter, in Denver, where it is treated at an average cost of $8 per ton. The ore, after roasting, is a very desirable smelting ore, as the percentage of silica is more than offset by the percentage of iron. Last summer the company erected a Huson tramway 1¼ miles long, to carry the ore from the mine down to timber line, where begins a good wagon road 11 miles to Seymour, the shipping point on the Rio Grande Southern Railroad. This tramway made it possible to work the mine all last winter despite the deep snows which always fall at high elevations in this San Juan country. Since February 1st the company has shipped 250 tons of ore, which has netted $21,000. There is 1,900 ft. of work done, consisting of six tunnels driven at a vertical elevation of about 100 ft., one above the other.

FLORIDA.

Marion County.

Dunellon Phosphate Mines.—These mines have passed under control of Messrs. Auchincloss, of Lake City. They have appointed A. G. Bigelow, manager.

GEORGIA.

Hall County.

(From our Traveling Correspondent.)

Near Gainesville, in this county, an experimental plant has been erected to test the practicability of a recently patented process for saving gold by dry chlorination. The results by this process, in the laboratory here, where experiments have been carried on for the past year, have been, it is said, really astonishing, and considerable interest has been manifested by the owners of refractory ore bodies. The process is protected by three patents, one on the roasters, one on the chemicals employed, and another on the amalgamator. The principle is to free the gold in refractory ores and afterward save it by amalgamation, instead of reducing it to a solution and saving it by precipitation, as in barrel chlorination. The roaster, in which the ore is placed, after being crushed fine enough for an 80 mesh screen, is patterned after the ordinary muffle in use in laboratories. This at present is being constructed 4 ft. wide by 7½ ft. long, with a capacity for roasting 600 lbs. of ore at each charge; from 1½ to 2 hours is the time necessary to perfect the roast, during which time, it is stated, because of the chlorination taking effect in the muffle, the iron contained in the ore becomes oxidiped and separated from the silica. After the crushed ore is placed in the muffle together with the chemicals, it is closed airtight and air is pumped into it through a tube, while the gas, as it is generated, is allowed to escape through another tube into a vat filled with water. When the roasting is completed the contents of the muffle are discharged into the amalgamator, which is 14 ft. long, and about 4 ft. in diameter, constructed of iron and circular in shape, with a gaspipe shaft from end to end, fitted with fans fastened to the shaft in such a manner as to form a spiral screw with the outside edges almost touching the inside surface of the amalgamator, which keep the ore agitated as they revolve at about 15 revolutions a minute, and bring every particle in contact with a mercurial bath in hot water with which the amalgamator is charged, 100 lbs. of quicksilver being used for that purpose. From 1½ to 2 hours is consumed in this process of amalgamation, which is claimed to save the greatest possible percentage of the gold contained in any refractory ore. The degree of heat required for roasting varies according to the elements contained in the ore, but from about 280° Fahr. to about 500° is the usual intensity required to oxidize any iron in combination with ore. In case of the presence of arsenic, it is claimed no trouble is met with in eliminating it, but where magnetic iron occurs in the ore, the difficulty is greater. The plant being tested at present is the first erected to treat ore in ton lots, and a run is now being made on sulphuretted ore from Arkansas. Negotiations are pending with a view of erecting one of these plants at the Camille mine, near Tallapoosa, Ga. The ore there is highly sulphuretted and, it is claimed, assays in some portions of the vein as high as $200 a ton. The patentees claim that a plant with a capacity for treating 15 tons daily can be erected complete, including engine, boilers and crushers for a cost not to exceed $6,000, and that the cost of treating ore by this process will not exceed $2 per ton. Although a portion of Hall County is on the gold belt of the Appalachian range, yet no mines are being worked within its boundaries, but a large number of prospects have been opened; the work performed though has invariably been of too shallow a nature to enable any reliable estimate of the values of the properties to be formed. At one point, about three miles from Gainesville, some capitalists from Minnesota have recently purchased a property, on which it is proposed to erect one of these new process plants. The ore so far discovered in this county is of a refactory nature, which, to some extent, accounts for the lack of development work and also for the interest manifested in the practical results by this new process.

Haralson County.

(From our Traveling Correspondent.)

At Tallapoosa the newly organized North Georgia Land and Manufacturing Company has got down to business, and the officers are making every effort to carry out the plans successfully, and repair so far as possible the damage caused by the mis-management of the defunct and notorious Georgia-Alabama Investment and Development Company. The officers of the new incorporation are as follows: President and general manager, O. F. Sampson; vice-president, A. I. Head; treasurer, W. H. Kimball; secretary, C. W. Fox; land agent, J. R. Knapp, all of Tallapoosa. The new company commences business free from debt and with cash in the treasury.

Lumpkin County.

Auraria District.—Mr. John Whitener has commenced operation with a large force of hands preparing for the erection of a 10-stamp mill and the sinking of a 200-ft. shaft. The property has already yielded some gold, having been worked down to watel level.

Phœnix Mine.—The company has now 12 men employed in the placer workings, and is taking out about $60 per day in gold.

IDAHO.

Owyhee County.

De Lamar Mining Company, Limited.—The official returns for June are as follows: Crushed during the month, 2,508 tons; bullion produced in the mill (estimating silver at 72c.), $59,385; estimated value of ore shipped to smelters, $9,413; miscellaneous revenue, $1,100; total revenue, $69,898; total expenses, $35,605; profit for the month of June, $34,293. Captain Plummer further reports that the Pelton water wheel has been successfully installed, has been running from July 5th, and has developed 100 H. P.; he anticipates there will be sufficient water to utilize the wheel for some time. The directors have declared an interim dividend (No. 9) of one shilling per share for the three months ending June 30th, 1893 (free of income tax), being at the rate of 20% per annum.

MICHIGAN.

Copper.

Centennial Mining Company.—This mine has shut down for the present, owing to the low price of copper.

Wolverine Mining Company.—A short time will see all the surface construction work completed, says the "Portage Lake Gazette." No. 2 shaft is a single skip shaft and has a balance car. The two shafts are 600 ft. apart. The stamp mill is doing good duty and stamping about 250 tons of rock every 24 hours. The mine is not being crowded during this time of cheap copper. The ground is well opened up ahead and the reserve of good ground to draw upon is quite large, so that when copper advances we shall expect to see their monthly output increase.

Iron—Marquette Range.

Lake Superior Iron Company.—The report of the treasurer for the year ending April 29th, 1893, shows as follows: Gross earnings, $1,370,783; expenses, $1,398,646, making a deficit of $27,863. But ore on hand is reckoned as cash, making the net earnings $172,030, after crediting depreciation account with $155,688 to offset a reduction in the valuation of the company's steamers, cost of special repairs at the mine, etc. The company had 196,608 tons of ore in stock on May 1st, 1892, mined 474,087 tons during the year, shipped 370,269 tons, and had 295,426 tons at mine April 29th, 1893. The company's six steamers, two of which were finished too late for a full season's work in 1893, transported 87,366 tons of ore from Marquette and 221,150 tons from Escanaba for the company's account, at average market rates, and 19,530 tons of ore, 79,631 tons of coal and 2,463 tons of grain at open market rates for outside customers, making a grand total of 410,140 tons. After writing off $67,550.74 for depreciation, the steamers earned a trifle over 6% on $852,550.74, which was their book valuation. A balance sheet, dated April 26th, 1893, is as follows: Resources—Real estate and mining property, $1,273,642; steamships (six steamers), $785,000; iron ore, $787,691; due from agents, $55,674; notes and accounts receivable, $164,856; cash, stocks, rents, etc., $32,973; treasury stock, $400,000; steamship operating (new account), $4,886; total, $3,504,724. Liabilities—Notes and accounts payable, $56,312; debt at mine, $93,804; interest, balance vs. company, $182; capital stock, $2,500,000. Reserves—Guaranty, $260,505.27; depreciation, $416,640.83; profit and loss, $177,280.50; total, $3,504,724.

Lucy Mining Company.—This company has ceased mining operations indefinitely, which throws between 30 and 40 men out of employment. It is not probable that the mine will be worked again under the present management. Too much royalty is probably the cause.

Winthrop Iron Company.—At this mine about 325 men are employed. At the time of the close-down several single men left the mine, and their places have been filled by married men, about 25 of them residing in Ishpeming. As at all the other mines in the Lake Superior region there will also be a cut of wages of the men employed here, this on account of the low selling price of ore.

At the South Winthrop the work of opening up the new vein continues, and ore is still showing on both ends of the drift.

Iron—Menominee Range.

Aragon Iron Company.—For some days there has been considerable excitement because of the continued failure of the Aragon mine to meet its obligations, says the "Norway Current," and this has culminated in the attachment by the Atlantic Powder Company of the piles of coal on hand. Supt. Larsson has said that there was approximately 40,000 tons of ore in stock, and the indebtedness for labor was about $45,000; that the suspension of operations was not on account of the stoppage of the loading of ore by the men, that they did the right thing to protect themselves, that he hoped to see the claims paid and work resumed in a short time.

Hamilton-Ludington Mines.—At these mines the water is practically out, and the connection between No. 2 Hamilton and the old part of the mine has been made also; also repair work in B shaft, Ludington. Such examinations as have been made go to show that No. 1 shaft, Hamilton, is pretty badly wrecked, "A" shaft Ludington is beyond repair, and that "C" shaft Ludington may be repaired sufficiently to enable bailers to be run in it to keep out the Ludington water. In the Ludington the water is being kept down to a point 10 or 15 ft. below the 10th level, while at the Hamilton it is kept at the 1,325 level. Since reaching this level in Hamilton shaft No. 2, it has been possible to keep a record of the "coming" water. During the first days this was 1,100 gallons per minute, but the quantity has been decreasing steadily, and recently the average was 926 gallons. It is thought by the management that when the mines shall have had time to drain through the upper levels, the flow will not exceed 800 gallons per minute, and even this estimate may be too high. Bailing began on June 19th, and the aggregate of the daily records showed on July 14th 87,017,954 gallons water bailed. During this time the water was lowered 896 ft. in the Ludingtohn and 1,325 ft. in the Hamilton.

MINNESOTA.

Duluth County.

(From our Special Correspondent.)

The rails of the Duluth, Missabe & Northern road reached that road's ore dock, in Duluth, July 22d, and ore shipping has already begun. Up to that date 30,000 tons had been sent over the road to temporary docks, mostly from the Biwabik mine. It is expected by the railroad people that the season's shipments will be not less than 500,000 tons. Shipments for the season to date over the Duluth & Iron Range road have been 421,124 gross tons, of which the Minnesota mines, at Tower, shipped 180,485, the Chandler, 215,836, and the Mesaba Range 25,000. Shipments from the Minnesota and Chandler are largely from stockpile, which, at the opening of navigation, held 600,000 tons.

Iron—Mesaba Range.

(From our Special Correspondent.)

Adams.—A majority interested in this mine, which is probably the largest bessemer ore body ever discovered, has been sold to the New York syndicate back of the Duluth, Missabe & Northern road, for $500,000. The mine claims 31,000,000 tons of Bessemer ore in sight.

Canton.—This mine, the property of the Minnesota Iron Company, which was closed two weeks ago, has resumed operations with a full force of 100 men. To the time of its closing it had shipped 16,000 tons.

Missabe Mountain.—This mine will not close down, as was intimated. On the contrary, it begins active shipments soon. A contract has been given to Drake, Stratton & Co., of Pittsburg, for stripping 200,000 cu. yds. of surface from the ore body. The steam shovels, four small locomotives and other machines, form the equipment, and are at work.

Iron—Vermillion Range.

Minnesota Iron Company.—At its last annual meeting, held a short time ago, this company passed its quarterly dividend. The following statement was given out in explanation: The capital stock of the company is $16,500,000. The property of the company now consists of the iron mines in Township 62—15, St. Louis County, thoroughly equipped for business with the most modern machinery, and mining now at the rate of 600,000 tons per year, and with not less than 4,000,000 tons of iron ore in sight; about 11,000 acres of land selected with reference to mining interests; about 2,700 acres of land at Two Harbors, on Lake Superior, the shipping port for the Duluth & Iron Range Railroad; the Duluth & Iron Range Railroad, 135 miles in length, thoroughly equipped in every respect, its ore docks, machine shops and yards at Two Harbors alone costing more than $1,200,000, and with a State land grant of about 500,000 acres, of which 184,000 acres have already been patented to them; the Chicago & Minnesota Ore Company, owning a majority of the stock of the Chandler mine, mining this year about 700,000 tons of ore; and also owning the Canton mine, mining this year about 100,000 tons; also various other organized companies owning in the aggregate about 24,000 acres of timber and mineral lands. The company also owns eight large steel steamers, four built in 1890, two in 1891, and two in 1892, their aggregate carrying capacity between docks at Two Harbors and Lake Erie ports being about 500,000 tons per annum. The steamers cost over $1,600,000. Much of the property mentioned, including the steamships, is represented by the stocks and bonds of proprietary companies, all of which are in the treasury of this company. The Duluth & Iron Range Railroad is subject to a mortgage of $5,209,000, interest 5% per annum, payable semi-annually. The net earnings of the entire property owned by the Minnesota Iron Company for the past five years, after paying interest on railroad bonds, have been $5,645,493.

The company has during that time paid dividends amounting to $2,745,000, leaving a balance of surplus earnings of $2,900,493.

Out of this surplus the entire payment for the steamers has been made, as well as large expenditures in improvement and enlargement of docks, track, machine shops and yards of the railroad company, and machinery and other improvements at the mines.

On May 1, 1893, the Minnesota Iron Company had on hand, including ore in stock, valued at cost, assets amounting to $2,429,390, while its total indebtedness was $379,094.

NEVADA.

(From our Special Correspondent.)

The Eureka & Palisade Railroad Company received in transit, during the month of June, to Vallejo Junction and Salt Lake, 2,973 tons of ore, made up as follows: From Eureka District, 2,732 tons; White Pine, 239 tons; Nye County, 2 tons.

Elko County.

(From our Special Correspondent.)

Dexter Gold Mining Company, Tuscarora.—Dividend No. 4 has just been declared, at the rate of 25 cents per share. This gold claim with one or two others are all that is keeping the camp alive at present.

Navajo Mining Company, Tuscarora.—The sum of $14,840 has been received at San Francisco, from recent sales of ore and bullion.

Storey County—Comstock Lode.

Belcher.—On the 200 level the raise between Nos. 1 and 2 crosscuts is up 22 ft., 7 ft. having been made during the week; the top shows porphyry. Southeast crosscut No. 2, on the same level, is out 10 ft., having been commenced during the week; the face shows porphyry. On the 350 level the east crosscut, 100 ft. north of the north winze, is out 66 ft., having been advanced 11 ft. during the week; the face shows porphyry and quartz of no value. On the 400 level southwest crosscut is out 347 ft., 10 ft. having been made during the week, the face is in porphyry and quartz of no value. The north raise from the end of the north drift is up 7 ft., having been commenced during the week; the face shows porphyry.

Confidence-Challenge.—No ore has been taken out of the mine during the week. Some necessary repairs have been going on.

Savage—On the 1,100 level east of the old stopes the miners continue to extract ore of good quality from the 3d floor up to the 15th floor. During the week they have hoisted 176 cars of ore from this level. Shipped to the Nevada mill 210 tons and milled 210 tons; car samples average $35; battery samples average $31.39. Bullion yield for the week, $4,863. Shipped to the U. S. Mint, Carson, July 13th, 312 pounds crude bullion. Men are employed on repairs and prospecting from the 1,100 to the 950 level; also a force of men are employed retimbering the main shaft above this level to the 750 station.

Segregated Belcher.—The work has been devoted to repairs on the 1,100 level, in the main lateral drift, and to preparations for extracting ore from that level.

Yellow Jacket.—At all important points on the 1,100 level, work continues. The winze is down 45 ft.; the bottom shows bunches of fair grade ore. Still continuing the southwest drift on the 1,200 level; the face is in quartz giving low essays. Making repairs to the incline down to the 1,300 level, preparatory to resuming work on that level.

(From our Special Correspondent.)

A struggle is now going on between the millowners and the farmers over the waters of the Carson River. There is not sufficient water to supply the wants of both and the controversy is pending in the form of a suit of equity, brought by the Union Mill and Mining Company against Farmer Daugberg and 104 other residents in the neighborhood. T. D. Edwards has been appointed special examiner by the U. S. Circuit Court, and he is receiving testimony in San Francisco. The suit of the Union Milling and Mining Company embraces, under the ruling on a previous case, the claims of many other mills in the same category, viz.: The Mexican, Brunswick, Santiago, Nevada, Franklin, Woodworth and Rock Point mills. The contention is that each of these mills is entitled to 7,000 miner's inches of water during all seasons, both as riparian owners and as prior appropriators. Colonel Coffin, of Virginia City, is solicitor and W. S. Wood, counsel for the mill companies, and R. M. Clark, of Carson, and W. E. F. Deal, of Virginia City, represent the farmers.

The following is the weekly tabulated statement of ore hoisted from Comstock mines and milled, with the car and battery assays, bullion shipments, etc.:

Mines.	Tons hoisted.	Car spl. assay.	Tons milled.	Av. Bty. assay.	Bill for work.	Bullion shipped.
Con. Cal. & Va	158	30·23	....	....	....	.....
Kentuck.....	210*	.....	....	.....	.....	.....
Potosi.....	658	29·38	676	26·80	$4,873.60	$6,496†
Savage.....	176‡	35·00	210	31·09	.....	312§

* Shipped to the Santiago Mill. † Received at San Francisco from sale of bullion. ‡ Cars. § Crude bullion.

The Miners' Union, of Virginia City, elected the following officers at the annual meeting held this week: President, Wm. O'Leary; vice-president, Dennis McMahon; financial and recording secretary, Bernard Coyle; treasurer, Andrew Young; warden, Michael Twohey; contractor, Alexander Kelly; financial committee: John F. McDonell, T. W. Flynn, William Allen; trustees: M. H. Burke, John Carroll, Michael James, Frank Monohan, Fred. Fissett; library directors: William J. Bollen, Michael Carroll, Joseph E. Casey, George Llewellen, John Rowe.

There is a possibility of trouble on the Comstock. Last week J. L. Flood, "Bob" Morrow and other of the magnates of the lode, held a meeting, at which it was agreed that expenses must be cut down. The secretaries, superintendents and accountants signed an agreement to accept a reduction of 25% in the salaries and a like reduction is proposed, and is to be enforced, upon all Comstock employees. Transportation, wood, lumber, water and other supplies are all to be cut down. The companies furnishing supplies of all kinds and transportation are all monopolies and can afford to reduce the prices that have ruled so long. The Virginia & Truckee Railroad is owned by D. O. Mills and the Sharon estate. The latter is also a large stockholder in the Virginia & Gold Hill Water Company, and controls several mines at the south end. In accordance with the scale of the Miners' Union, $4 per day is the lowest rate of wages paid. Carpenters receive $5 and mechanics $6 per day.

The matter will be discussed at the next meeting of the Miners' Union, but the report is current that that organization will not consent to any reduction in wages. It is hard to understand, however, what fight the miners can make, for after current expenses are paid they, almost to a man, throw their surplus cash into the stock market.

Consolidated California & Virginia Mining Company.—It is interesting to note one or two facts in connection with the bullion statement for the month of June made public a week ago. The 1,334 tons of ore milled yielded in bullion $33,319, or a yield per ton of $24.975. The battery value of the ore was $27.94, and the car sample averaged $30.67. Here is the point: The battery value was 91% of the car sample, and the yield in bullion was 81·43% of the car sample. In the light of the fact that in and out of season efforts have been and are being made to discredit the car sample assay, the above figures are very suggestive.

Crown Point Mining Company.—The test run of gold ore at the Mexican mine is reported to be favorable, but details are not to hand. The mine, however, will start up next week, with a full force.

Savage Mining Company.—The annual meeting of this company was held July 21st, and was somewhat lively. The old Board of Directors was reelected as follows: G. R. Wells, president; C. H. Fish, vice-president; J. Anderson, W. S. Wood and Herman Zadig, directors. E. B. Holmes was reelected secretary and R. C. Keating superintendent. The secretary's report showed an overdraft of $8,022. From the superintendent's report it was gleaned that during the year there were taken out 18,372½ tons of ore, which yielded $282,378 in bullion; the discount on this was $75,341, and the net coin value was $207,038. The average car sample was $23.38, the average battery sample $20.85, and the percentage obtained 77·37%. The Mining Stock Association, through its secretary, submitted a protest. The directors have a very good idea what protests emanating from such a quarter mean, and so they refused to hear it read, and, on motion, it was decided to place it on file. Mr. Tingman, however, insisted upon reading the protest as a stockholder.

Union Consolidated Mining Company.—The Union-Sierra Nevada joint drift, 900 level, has cut the red ledge about 3,000 ft. in, and mention of the fact is made for the first time this week. This is the continuation of the West Consolidated Virginia gold ledge about which there has, from time to time, been so much talk. The joint drift was run further west about 400 ft. when, not finding anything that promised well, steps were taken to commence work and open the vein.

White Pine County.

(Reported for the "Engineering and Mining Journal.")

The gold belt of Ely has been partially developed on the south side of Robinson Canyon, two miles west of the town, which is the county seat of White Pine County. Development so far has been confined to the Altman, Chainman and Joana, but prospecting on other properties has demonstrated the fact that good pay ore is not by any means confined to the mines named. The belt proper is about 4,000 ft. in width, the trend being N. E. by S. W. with porphyry on the east and lime on the west. Owing to extremely dull times very little has been done in the way of mining for a couple of years, with the exception of the Chainman, from which ore to the value of nearly $75,000 was taken and milled on the ground during the summer of 1892. A sale of the mine to Marcus Daly and the Anaconda people, of Montana, for a good round price is now pending, and a small force of miners, under the superintendency of D. H. Jackson, who conducted the negotiations for the sale, are employed in prospecting the lower or water levels. An immense body of ore, averaging about $21.60 per ton in gold, is uncovered in this mine, but as the water level has been reached throughout the mine, a large pumping plant will have to be put in before anything like active operations can be resumed. As the ore is not altogether free, being partially base, the mill must be greatly altered or replaced by an entirely new plant.

A sale of the Joana, also to Montana people, was consummated during the early spring, and a bonus of something like $7,500 paid down, but owing to the stringency of the money market or from other causes the completion of the deal and the passing of the property are still in abeyance.

The Altman, a patented mine, owned in Canton, O., adjoins the Chainman, on the south. This mine is now lying idle, but has, during the past few years, produced a large amount of good pay ore.

Several good prospects close to and adjoining the properties mentioned are being developed at the present time. Among these might be mentioned the Los Angeles, owned by A. L. Tyler, Will Watson and Leach Bros. This property is close to the Chainman, on the southwest, and adjoins the Rob Roy, a fairly well developed and valuable mine, owned by Carpenter & Watson. At a depth of 20 ft. a vein of free milling, gold-bearing quartz was cut, which averages $44 per ton. The ore is very free and easily mined. A few weeks ago the property was bonded to D. H. Jackson, mentioned above in connection with the sale of the Chainman, for $25,000, the present consideration being that Mr. Jackson shall sink a shaft 200 ft. This work is now being carried out by a force sufficient to insure its completion before winter.

Ex-State Senator Tom Rockhill, an old and experienced prospector, made a discovery of gold-bearing quartz on the belt, about 1½ miles southwest of the Chainman, a short time ago. His attention was attracted to large quantities of quartz bowlders, which, on being assayed, showed a value of from $40 to $45 gold per ton. Mr. Rockhill and his partner, Newt. Boyd, broke and corded up some 200 tons of this ore while searching for the ledge. In their explorations they invariably encountered what seemed to be a cap rock of lime, and finally came to the conclusion that the ledge lay below this cap, and on sinking in the lime their judgment was confirmed, as at a depth of only about 6 ft. they broke through the lime and came upon the ledge, which is well defined and assays about the same as the bowlders encountered on the surface. The ore is not free, and will be treated by the cyanide process. Mr. Jackson has also acquired this property and has put a small force of men to work in opening up the ledge.

NEW YORK.

Orange County.

Poughkeepsie Iron Ore Company.—The Forest of Dean mines, owned and operated by this company, have closed down for an indefinite period. These mines have been operated without interruption for the past hundred years. The reason for the closing is said to be increased cost of mining here, while ore can be more cheaply obtained from other points.

OHIO.

Oil.

A press dispatch says that at the village of Waterville, 15 miles west of Toledo, remarkable oil strikes have recently been made. Discoveries in territory that was prospected and abandoned 30 years ago have led to the leasing by speculators of a large area of territory. Several wells have been opened. Two wells are flowing 600 barrels a day, and several others are running 200 and 400.

PENNSYLVANIA.

Anthracite Coal.

Kingston Coal Company.—An explosion of a large body of coal gas at the No. 4 shaft of this company, at Edwardsville, killed four miners. The part of the mine where the explosion occurred is very gaseous, an explosion having occurred there about two weeks ago. The bottom of the slope is about two miles from the mouth of the shaft, and is located near West Side Park. The cause of the explosion is not known, as the four burned men were the only ones in that part of the mine at the time.

Pennsylvania Colliery.—The act of a careless loader in igniting the canvas of a battery in the counter of No. 3 slope at Green Ridge has threatened destruction to the entire mine, and as a consequence has thrown over 1,000 employees out of work. The fire has continued to rage with unabated vigor ever since until it has spread over a large surface. Company officials and those experienced in combating mine fires have been upon the scene, and until recently it was deemed necessary to flood the mine. Later developments make it probable that the fire can be quenched by shutting off the effected portion of the mine from the other workings. A plan suggested is to partition off the three gangways leading to the burning district, and to fill up the section shut off with water, slush and cement from an opening to be bored overhead. Should this idea prove feasible the remaining part of the mine can be worked as usual. It is to be hoped that this, one of the most important collieries in the neighborhood, will be enabled to resume work in the near future.

Stevens Colliery.—A heavy fall of rock and slate occurring near the foot of a slope, several men were instantly killed and others injured.

(From our Special Correspondent.)

Delaware, Lackawanna & Western Railroad Company.—The Pettebone colliery of this company, located near Wilkes-Barre, will be idle for several months, in consequence of the fire which resulted from the recent explosion of gas in the Cooper vein. The officials of the company have made strenuous efforts to extinguish this fire, but it has gotten beyond their control, and as a last resort they have commenced to flood the mine by pumping water into the shaft from the Susquehanna River. It will take about a month's continuous pumping to fill the mine with water up to the level of the fire in the Cooper vein, as it will be necessary first to flood the underlying Baltimore and Red Ash veins, which have been extensively worked at this colliery. The damage from the fire and flooding of the mines will entail a considerable loss upon the company, and it will take the greater part of a year to get the colliery again in shape for resumption of mining. About 650 men were employed at this colliery.

Bituminous Coal.

Berwind-White Coal Mining Company.—The mines belonging to the Weaver and Jones estates in Somerset County, have been bought by this company. The tracts contain 700 acres. The price paid for the coal was only $8,000. This company now owns a field of 4,000 acres of coal along Paint and Shade creeks in Somerset and Cambria counties.

Saw Mill Run Coal Company.—The strike of the coal miners at the Banksville mines of this company is still in progress. The pit committee of the Saw Mill Run Coal Company mine made an effort to settle the trouble but did not succeed, and a second attempt likewise failed.

Coke.

H. C. Frick Coke Company.—This company has for some years been working on the problem of a reservoir that would hold out the year round, thus preventing a loss of time on account of the failure of the water supply during the summer. The company has decided upon the building of a reservoir above White Rock on the south side of the Yough, at Connellsville. It will be the largest reservoir in the region, and will have a capacity of more than 3,000,000 gallons. It will be 228×123 ft., with a depth of 15 ft., and will cost about $200,000.

Northampton County—Slate.

Ellis Slate Company.—This company has about completed the uncovering of a large section of addition to its quarry, which will greatly increase the present shipping capacity.

Old Lehigh Slate Company.—This company is putting in a new hoisting apparatus with the Flory & Co. double drum hoisting engine.

Wyoming County.

Grand Rapids Coal Company.—This company is building a new breaker and sinking a slope in the ravine on the road leading to Wyoming Camp Ground. The slope is down about 300 ft., and is sunk alongside of the Butter Tub shaft, opened some years ago and abandoned on account of the poor quality of the coal near the outcrops of the vein.

SOUTH DAKOTA.

Custer County.

Caribou Mines.—This group consists of four claims lying parallel to each other, making about 40 acres covering a space of 1,500 ft. in length by 1,200 ft. in width, situated about one-half mile south of the Keystone. The tunnel is now in 105 ft. The result of many tests of the ore has shown that, while it is low-grade, it can be profitably worked.

Pennington County.

Union Hill Mine.—Work on the tunnel is steadily progressing, the face being now in 230 ft., and it is expected that the ore body will be cut in 70 ft. more. An open cut and shaft have been sunk 60 ft. on the vein at about 100 ft. from the apex of the hill, and a winze will be run up from the tunnel when it reaches a point beneath. The shaft exposes a large body of gray rock carrying pyrites containing gold.

TENNESSEE.

Rhea County.

Dayton Coal and Iron Company.—This company has given notice of a reduction of 10% in wages to date from August 1st.

UTAH.

Cache County.

Mercur Mine.—The manager says that everything is running smoothly at this mine. About 40 tons of ore is treated per day. The mine is still holding its own, and the ore body is showing well.

Rich-Cache Mining Company.—This company, which owns some copper mines on the line between Rich and Cache counties, is meeting with good success in the development work, a rich strike having been made recently at the Daisy mine.

Emery County.

(Reported for the "Engineering and Mining Journal.")

For the following information concerning mining in the Henry Mountains, we are indebted to M. C. Bryan, of Ferro. No extensive work has been done as yet, although the camp is progressing very rapidly. Two small mills are in operation, and as they are more than paying expenses it is probable that they will be enlarged soon. Placer miners are making $5 to $10 per day. Many of the claims cannot be worked at present as no water is available. The Henry Mountain Mining Company has located the west extension of the Bromide and adjoining claims as well as the Tenny. On this latter an 85-ft. tunnel has disclosed a large body of decomposed quartz and manganese. A mill run of 40 tons yielded $32 gold and 8% copper. A 128-acre placer mine located by J. F. Wilson has yielded $2,700 in four months, with the use of dry washing machines. It is owned by J. W. Tomlinson, of Denver, who is spending large sums preparatory to installing hydraulicking machinery later on. It is estimated, when the plant is in operation, $200,000 will be taken out annually. Many of the claims are held at low figures, as prospectors without capital are not able to handle them. There are over 1,000 people in these mountains now, mining and prospecting, and the number is increasing daily.

The Jack Summers claim was sold recently for $50,000, and several others from $10,000 to $15,000.

Millard County.

Detroit District.—Considerable interest is being manifested in this district by new developments in the Rattler and Ibex mines, says the "Millard County Blade." In the former mine a recent strike of silver ore was uncovered, assaying $37.41 silver, $25 gold and 11% copper. It is understood that shipments from this mine will be made regularly, commencing in July, Tintic being the place where the ore is to be treated. The ore in question carries a large per cent. of iron, and from this fact is very desirable for smelting purposes.

Piute County.

Utah Mine.—A shipment of 20 tons of ore has been made from this mine at Fish Springs. The assay value of the ore was 36% lead and 242 oz. of silver per ton. This ore had to be hauled a long distance by wagon before reaching the railroad, at a cost of $17 per ton. This will probably be the last shipment from the mine until silver and lead advance to where it is profitable to work mines.

Salt Lake County.

The cash bonus of $25,000 paid to the syndicate constructing the copper plant at Salt Lake City, is to be returned to the city treasury, the syndicate having agreed to accept $25,000 of the city's bonds instead of cash.

North Chance Mine.—A force of 18 men is still being worked and the ore taken out is of good quality. The mill has been closed down, but this is said to be temporary.

Tiwaukee.—A hand jig is now in operation on the low-grade ores. It would seem most doubtful whether this will pay even day's wages.

Summit County.

According to the "Salt Lake Tribune" the employers and employes of the Ontario and Daly Mining companies have agreed to the following reduction in wages: Four-dollar men reduced to $3.60; $3.50 men reduced to $3; $3 men reduced to $2.75. This is reported to be mutually satisfactory, and the word was that work would proceed on the reduced scale. This result, which was obtained with difficulty, was necessary to keep the mines going, as it was evident from the low price of silver that they could not keep it running at a loss so great as the difference between silver rates and mine expenses would necessarily be. Mr. Chambers offered a proposition to reduce the wages 20% all around, with the provision that when silver should go up to a point to warrant it the old wages would be restored. This was at first refused, but further consultation brought about the arrangement stated above.

VERMONT.

Rutland County.

Vermont Marble Company.—This company, which owns a number of quarries and employs about 1,000 men, has given notice of a reduction of 15% in wages.

VIRGINIA.

Wise County.

Wise County Coal and Coke Company.—This company is building 100 coke ovens near Coeburn at a point convenient to its mines.

WEST VIRGINIA.

Fayette County.

Star Coal and Coke Company.—This company has been incorporated by C. T. Jones, George W. Jones, William D. Thurmond, Joseph F. Thurmond and L. G. Gaines to mine coal and make coke near Oak Hill.

Marion County.

Worthington Coal and Coke Company.—This company has been incorporated to mine coal near Fairmont. The capital stock is $100,000.

FOREIGN MINING NEWS.

BELGIUM.

The Beaubrun colliery, at Saint-Etienne, was recently put up for sale at the upset price of 5,000,000 francs or $1,000,000, and was ultimately bought by the Société des Mines de la Loire for 10,100,000 francs (say $2,020,000).

BRAZIL.

Ouro Preto Mining Company, Limited.—The returns for the month of June are: 3,023 tons produced 31,137 grammes, equal to 1,001 oz.

BRITISH COLUMBIA.

(From an Occasional Correspondent.)

Blue Bird.—An eighth interest in this mine has been sold by W. H. Taylor, of Spokane, to J. L. Montgomery for $6,500 cash. The other owners of the Blue Bird are all Spokane men, viz.: John M. Burke, D. C. Corbin and W. S. Norman.

Bonanza King.—The owners have let a contract for the hauling of 100 tons of ore to Kaslo to George Hughes. The price to be paid is $30 per ton.

Kaslo Slocan.—A half interest in the Washington mine has been sold by Jefferson & Clarke, of Spokane, Wash., who retain the other half themselves, to J. L. Montgomery, of New York, for $85,000 cash.

Kaslo-Slocan.

(Reported for the "Engineering and Mining Journal.")

For the following information concerning the mines in this district we are indebted to Mr. Philip O. Stoers.

The Noble Five group has been developed by a 150-ft. tunnel at a cost of $6,000. No ore has been shipped as yet. Ten thousand dollars, which has run 600 ft. of tunnel and six miles of trail, has been expended on the Blue Bird. One hundred tons ore, averaging $150 silver per ton, has been shipped from this property. Twenty thousand dollars in development work on the Freddy Lee has produced 30 tons of ore running over $100 silver. The Dodenell's mine has expended $45,000 in development work at a four-mile trail. A shipment of 10 tons yielded over $1,600. Fifteen tons of ore shipped from the Best mine yielded over $160 per ton. One thousand dollars has been expended on this property for development work. From the Idaho 15 tons have been shipped and from the White Water 15 tons. The majority of these claims were discovered after April, 1892. The owners have been obliged to contend with the severe winter, a want of roads and low freight rates. Hauling from the Freddy mine, Kaslo, a distance of 25 miles, was $40 per ton, and to this must be added a freight from Kaslo to Helena or Tacoma some $16 per ton, and then smelting charges and duty on the lead, amounting to $22 per ton more, must be paid before a profit can be made. However, from this property 400 tons have been shipped at satisfactory profit. At the present time nearly all the claims are working, and it is extremely probable that the Canadian Pacific will build near the Slocan via Nakust and New Denver. The Ainsworth and Trail Creek regions output is also good. In the Nelson district the Poorman is the only mine working. The first clean-up of the Pend d'Oreille Placer Mining Company yielded only $60 in gold from 130 cubic yards. The earth was taken from the surface.

Slocan.

Advices from Spokane say that the smelters want Slocan ore and are still buying it.

Cumberland.—The tunnel is in 140 ft. The mine lies below the Idaho and has an 18-in. vein of high grade ore.

Freddie Lee.—This mine has shut down pending the present low price for silver.

Idaho Mine.—The lessee is running two tunnels and is now in 30 ft. on each. Ten men are employed and a shipment of three carloads will soon be made.

CHILI.

The president in his recent message to Congress spoke of the nitrate industry as follows: The nitrate industry has followed a prosperous course of development. The production, which in 1888 was 7,800,000 metrical quintals, will in the present year exceed 10,000,000, and there is every reason to presume that its progress will continue in like proportion. I consider that the State should co-operate in the promotion of the use of nitrate. The interests of the public revenue and those of the nitrate makers are in harmony, and it is to be hoped that the latter, being sensible of this, will not, with the object of obtaining a higher rate of profit, reduce the production to a quantity insufficient to satisfy the requirements of consumption. In that case, the time will have arrived for the adoption of legislative measures to prevent the excessive limitations of production, in the interests of both the public revenue and of the nitrate industry.

ENGLAND.

According to a telegram received to-day, 350,000 coal miners went on strike in consequence of the refusal of the operators to adopt the schedule of the Miners' Confederation.

INDIA.

During the first six months of the year the output of the Color District was 104,051 oz., against 163,140 oz. for the whole of 1892, and 130,137 oz. for the whole of 1891. The individual outputs for June were as follows: Mysore, 5,323 in June; six months, 36,712 oz. Ooregum, 6,307 oz. in June; six months, 35,937 oz. Nundydroog, 2,114 oz. in June; six months, 13,268 oz. Champion Reef, 2,843 oz. in June; six months, 13,883 oz. Balaghat, 292 oz. in June; six months, 4,149 oz.

MEXICO.

Mesquital Del Oro Mining Company.—The returns for June were as follows: Fifty stamps ran 570 hours (23 days 18 hours); quantity of ore crushed, 2,638 tons; bullion produced at clean-up, 980 oz.; value about £3,590; copper bars remitted, value about £60.

NEW BRUNSWICK.

Memramcook Gold Mining Company.—The following officers have been elected for this new company: J. B. Neilly, Halifax, president; A. C. Vanmeter, Moncton; J. E. Masters, Moncton; J. W. Y. Smith, Dorchester, vice-president; W. Fowler, Sackville; T. N. Campbell, Amherst; F. P. Prince, Truro; W. S. Covert, Halifax, secretary; A. N. Whitman, Halifax, and Fred. W. Summers, treasurer. The office of the company will be at the mines.

NEW SOUTH WALES.

British Broken Hill Proprietary Company, Limited.—The secretary of this company has issued a circular to the shareholders stating that: The directors have to announce to you that, as was stated at the recent half-yearly meeting to be probable, they are now under the necessity of shutting down the smelting furnaces at the mine. The recent rapid fall in the value of silver has rendered this step unavoidable, since at the present prices of both silver and lead, a weekly loss is incurred by the reduction of ores yielding no more than the lately published averages. The cessation of work in this department must necessarily continue until we strike a richer band of ore, or until prices of the metals which we produce advance materially. In the mean time the exploration of the mine will be steadily continued, though at a reduced expenditure, and it is still hoped that richer material may be found. The directors are led to believe that their lead ores may meet with a good local demand for fluxing purposes, and they hope to dispose of some quantity of them in this way on remunerative terms.

SARDINIA.

From a recent report of the British consul at Cagliari it seems that the production of lead and zinc in this country is increasing. Last year the total production of all metals was 173,731 tons, valued at £836,912, of which £523,080 was the value of cala mine or zinc ore. The number of persons employed in mining was 11,820; the average daily wages of a Sardinian miner are about 40 cents. Next in importance to zinc among the Sardinian metals is lead, the value of the production of which during 1892 was £225,960, silver, lignite, antimony, iron and manganese coming next in importance The greater part of the Sardinian metals goes to Belgium. Salt is produced in considerable quantities and goes mostly to Italy.

SOUTH AFRICA.

Transvaal.

Witwatersrand.—This district has again broken its record. A telegram received at London gives the output for June at 122,907 oz. of silver against 116,961 oz. in May and 103,252 oz. in June, 1892, and 55,864 oz. in June, 1891. The monthly output since January has been as follows: January, 108,374 oz.; February, 93,252 oz.; March, 111,474 oz.; April, 112,053 oz.; May, 116,911 oz., and June, 122,907 oz. Total for six months, 664,971 oz., against 1,210,868 oz. for the 12 months of 1892, and 729,238 oz. for 1891. The largest producers on the Rand during June were the Robinson, 14,226 oz., Lanrglaate Estate, 17,943 oz.; New Primrose, 6,961 oz.; Durban-Roodeport, 5,233 oz.; Nigel, 5,155 oz. All the others produced less than 5,000 oz.

The latest news from this district has confirmed to a wonderful degree the report made upon the deep levels by Mr. Hamilton Smith, Jr. In other words, the South Reef has been discovered at a depth of 2,334 ft. and at a distance south of 4,000 ft. from the Sunmer and Jack property on the Main Reef, and the Main Reef itself was found at a depth of 2,391 ft., and the drill was still in ore at a depth of 2,391 ft. Some very interesting facts have also been discovered, and that is that the banket to the south inclines at a smaller angle. For example, at 400 ft. below the surface the dip is 50°, at 1,000 ft. 45°, at 1,800 ft. 22°, and at 2,399 ft. only 16°. Also, the spot where the South Reef was discovered the reefs dip at an angle of only 30 to 40°, while on the Farm Turffontein, where the Robinson, Salisbury, Jubilee, Ferreira and other well known properties are situated, the dip is from 70 to 85°.

MINING STOCKS.

[For complete quotations of shares listed in New York, Boston, San Francisco, Aspen, Colo.; Baltimore, Pittsburg, Deadwood, S. Dak.; St. Louis, Helena, Mont.; London and Paris, see pages 128, 129 and 130.]

NEW YORK, Friday Evening, July 28.

The market has fallen from bad to worse than bad. Two weeks ago we took notice of the fact that there had been but five sales of dividend paying stocks, and but four sales of non-dividend paying stocks. Last week we could report but one sale of dividend stock and only two sales of a non-dividend stock. This week we can report but one sale, namely, 100 shares of Consolidated California & Virginia, @ $1.20. There has been an increased demand for gold stocks but we have no sale to report.

The superintendent of the Horn Silver reports that he is shipping at the rate of 1,200 tons per month, against 1,800 tons three months ago. He adds: Everything at the mines is in good shape. I canceled all orders for machinery, supplies and material so far as I could, for the present. Utah is more properous in these distressing times than any of the other Western States.

The statement of the Horn Silver Mining Company, for the three months ending June 30th, 1893, is as follows: Balance, per last quarterly report, April 1st, $286,950; receipts, sales of ore, $134,870; miscellaneous, $4,095; total, $425,915; disbursements, mining, labor, supplies, timbering and dead work, $33,541; general expenses and miscellaneous expenses, $6,641; dividends, No. 30, regular dividend of 12½c. and extra dividend of 7½c. per share, $80,000; balance cash on hand, $305,733.65.

Boston. July 27.

(From our Special Correspondent.)

The market this week has continued on the downward track, the dividend stocks suffering with the rest. It is almost impossible to get money on the best of collaterals, and this fact has forced liquidation in such stocks as Calumet & Hecla and Tamarack, which have declined in consequence to the lowest prices for a long period, the former selling off from $260 to $250, and the latter from $130 to $113.

Quincy has been freely offered this week and shows a decline from $100 to $80.

Osceola has been quite strong and only declined from $23 to $21½, the lowest price being for small lots.

Centennial, and the speculative list generally, have been neglected. Centennial sold down to $1½ and rallied to $1⅝. Kearsarge steady at $5¼, and Feanklin at $9¼@$9⅜. Atlantic sold at $7¼, an advance of the fraction.

The Montana group of stocks was fairly strong early in the week, Boston & Montana advancing to $17½; but a flood of stock coming on the market yesterday, in the absence of any demand, caused a decline to $15½, rallying to $16 to-day. Butte & Boston dropped from $5¾ to $5, on sales of about 1,500 shares.

Napa Quicksilver sold at $4 for 100 shares, a decline from the last sale (January 26th) of $1¾ per share.

San Francisco. July 21.

(From our Special Correspondent.)

The mining stock mrrket, in common with other lines of business, is passing through a time of depression unprecedented in the history of the city. At the early session of the San Francisco Board yesterday morning the aggregated sales amounted to less than $6.0, and on no one day during the week have the sales amounted to a tithe of the business done a year ago, despite the fact that even then trading was inactive.

In order that the Comstock mining companies may not collapse altogether, and their interest and those of the two Exchanges are identical, the reduction of expenses along the entire line is considered an excellent thing, always excepting the miners, however. As compared with the horde of high-priced officials the miners have made a poor showing on the salary list, and there is no inclination being displayed on the street to cut the wage-list of the actual workers. With rates for transportation, wood and water cut down, and a heavy reduction made in the salaries of the officials, the mines could be worked at a profit. The aim, however, of the "ring" is not now, any more than at any previous time during the last decade, to work the mines at a profit. The purpose of the reductions inaugurated this week by the Savage Mining Company is to go lighter with the assessments, for it has been apparent during the past year that the public were getting very tired of constantly paying the levies continually being made.

Meantime the stock market is paralyzed. This morning there were only five sales made, amounting to 600 shares. Consolidated California & Virginia sold steady throughout the day for $1.25; Ophir for 75c.; Mexican for 40c.; Union for 35c., and Sierra Nevada for 45c.

In the middle group of stocks Best & Belcher sold for 60c.; Chollar for 35c.; Gould & Curry for 37c.; Hale & Norcross for 8c.; Potosi for 50c., and Savage for 40c.

In the South End and also the Gold Hill stocks the dullness is just as pronounced as elsewhere on the lode.

Belcher was this morning at 35c., Exchequer at 2c., Overman at 12c., and Yellow Jacket at 53c.

Naturally with such a market outside stocks have been left severely alone. Mayflower only has sold steady at $2.10, but then it is a Californian property and on a paying basis, in this being the solitary exception on the list of stocks.

London. July 19.

(From our Special Correspondent.)

The excitement due to Indian silver legislation and its consequences apparently died out for the time and very few transactions are recorded in American silver shares, or, for that matter, in any other American mining shares. There are practically no offers, and quotations remain unaltered and quite nominal. Everyone is waiting anxiously for the meeting of Congress next month and the general impression here is that the repeal of the Sherman law will not be effected without great opposition and delay.

American mining shares have been overlooked during the past week for another reason also. The bad state of American investments, particularly railroad stocks, has made it necessary for many dealers to sell out South Africans in order to make themselves solvent. South Africans, both gold and diamond, have been very freely offered for this reason, and in the general depression of the times, buyers are naturally hard to find. Consequently the prices of these stocks, though excellent in themselves, have declined to almost panic prices. Amid all this excitement Americans have been lost sight of almost entirely.

In my last letter I mentioned that the fortnightly settlement of July 11th and 12th had carried several good brokers down, and that it was a period of great anxiety. It turned out eventually that the wreckage caught by the settlement was less than had been expected, as some prominent men secured relief at the last moment. There are ugly rumors in the air at the present time with regard to other houses expected to go to smash at next week's settlement, and the speculative market is overcast and transactions checked in consequence. It is by no means certain, however, that any difficulty will be felt; in fact the fears at present displayed are really exaggerated.

It is almost impossible to specify transactions in any American mining stock. It can only be said that Poormans have risen 6d. on the strength of the exchange of four shares in the Consolidated Company for three in the present one; that there have been the usual meaningless fluctuations in Golden Feathers, Golden Gates and Jackson Goldfields, and that there have been a few buyers in Holcomb Valleys. Prominent stocks like Elkhorns, De Lamars, Jay Hawks, etc., have had a few buyers, but no variation in prices is recorded, nor has anything like speculation taken place.

The directors of the Yankee Girl Silver Mines announce that it is their intention to recommend the reconstruction of the company, and the value of the shares has fallen slightly on the news. The proposition will be brought before the shareholders at a meeting to be held July 25th. Until then no detailed information can be obtained.

A few weeks ago I reported that Mr. William Frecheville had been asked by the shareholders of the Palmarejo Company, Mexico, to go out to examine and report on the mine, in order that they should have something definite to go on for the future of the mine. Though Mr. Frecheville was in the United States at the time he received the commission, he has since declined to proceed to Mexico and fulfill the commission, giving as his reason overwork and bad health. Mr. Hooper, of the firm of Bewick, Moreing & Hooper, has taken the commission instead, and is now on his way to the mine.

DIVIDENDS.

Mayflower Gravel Mining Company, of Placer County, Cal., dividend No. 19, of 10 cents per share, July 19th.

W. Y. O. D. Mining Company; paid dividend No. 14, of 10 cents per share, July 20th, at the office of the company in Grass Valley, California.

MEETINGS.

Nebraska & Colorado Mining Company, at the office of the company, Room 545 Equitable Building, Denver, Colo., August 15th, at 10 a. m.

Calumet & Hecla Mining Company, at the office of the company in Boston, Mass., August 16th, at 12 o'clock noon.

METAL MARKET.

NEW YORK, Friday Evening, July 28.

Prices of Silver per Ounce Troy.

July.	St. Ex.	London Pence.	N.Y. Cts.	Value of sil. in $1.	July.	St. Ex.	London Pence.	N. Y. Cts.	Value of sil. in $1.
22	4·83⅛	32⅛	69	0·533	26	4·82¾	32¾	69¾	0·539
24	4·83⅛	32⅛	69	0·533	27	4·81¾	32⅛	69⅞	0·540
25	4·83½	32¼	69¼	0·535	28	4·81¾	32½	69¾	0·539

Demand for silver for prompt shipment has been good. Exchange with China has favored the Eastern banks, and their margin for profit has been unusually large. If, however, the present financial strain in this country continues so severe for any length of time Eastern importations of stocks, etc., will be seriously curtailed, and the demand for silver may not be sufficient to support the present price.

The United States Assay Office at New York reports the total receipts of silver for the week to be 51,000 oz.

Gold and Silver Exports and Imports at New York, Week Ending July 22d, 1893, and for Years from January 1st, 1893, 1892.

	Gold.		Silver.		Excess of
	Exports.	Imports.	Exports.	Imports.	Exports.
Week....	$5,500	$1,173,893	$1,123,500	$30,149	*
1893.....	68,883,142	9,858,697	18,977,086	1,386,494	76,615,037
1892.....	45,954,573	6,548,906	12,141,440	947,905	50,599,202

*Imports in excess of exports, $75,042.

The imports of gold and silver during the week ending July 22d, 1893, were as follows:

From—	Gold.	Silver.
England	$212,667	...
Germany	340,759	....
South America	31,244	$27,774
West Indies	589,223	2,375
Total	$1,173 893	$30,149

During the five days ending Friday, July 28th, the exports and imports, so far as ascertained, have been as follows: Exports, gold, none; silver, $612,850. Imports, gold $1,511,993; silver, none. Of the imports $336,789 in gold came from Bremen, $121,663 from Liverpool, $500,000 from Havana, and $122,000 in American coin from the West Indies. The rest came from South America.

NOTES OF THE WEEK.

Meetings throughout the country both for and against the free coinage of silver and the repeal of the Sherman bill have been the order of the week. At Butte City, Mont., a meeting of the merchants was held July 25th, at which resolutions were adopted declaring they would not in any case patronize any house or use the products of any manufactories the owners of which are known to be antagonistic to free coinage, and the natural circulation and extended scope of the silver dollar as a debt-paying medium. On the same day a meeting held at Great Falls, Mont., adopted resolutions in favor of free coinage. Similar meetings have been held throughout Utah, Colorado and Nevada. At the same time preparations are being made for the silver convention to be held in Chicago, commencing August 1st. While this movement in favor of silver is going on, banks are failing, mills are shutting down, and railroad and industrial stocks are suffering a depreciation in value greater than at any time since 1873.

Chambers of commerce throughout the Mississippi, Eastern Southern and States are adopting resolutions urging upon Congress not only the repeal of the Sherman bill, but also that the repeal shall be unaccompanied by compromises which may still further embarrass the business and prosperity of the country.

There is now no doubt but that the Sherman bill will be repealed. Free coinage men themselves acknowledge this. Senator Teller, in an interview in Denver, said that the bill would be repealed, but that a compromise measure in favor of silver would be adopted. Senator Stewart, of Nevada, says he has no doubt that the Sherman bill will be repealed, and he is not overconfident that a substitute will be provided. In an interview with the New York "World" he said: "The repeal of the Sherman act might give temporary relief by deceiving the people and making them believe that the evil has been removed. But the evil lies deeper. It is a deficiency of gold. I have no doubt that the Sherman silver law will be repealed. But if it is repealed without a substitute of some kind, it seems inevitably certain that times will grow worse and continue to grow worse for a very long time to come. The output of gold is now consumed by the arts. There is no visible possibility of increasing the supply. The gold coin is all in use where it now exists. How and in what way a sufficient supply of coin can be obtained is unknown. My investigations teach me that it is impossible to obtain such a supply. Gold has already appreciated since silver was rejected as money of ultimate payment fully 50% and perhaps 60%. It must go on appreciating and property must go on declining in price. Perpetual appreciation of gold, or, what is the same thing, perpetual decline in prices, means stagnation, misery and hard times for the human race. Any means that will avert this will be satisfactory to me. I am wedded to no theory, but willing to be convinced on any subject, and if the gold men can show me any possible way of restoring prosperity on their theory I will waive any preconceived notions which I may have. I simply want to see daylight."

On Monday, July 24th, the amount of clearing-house certificates outstanding was $22,100,000. During the week a small amount was returned, but on Thursday $1,335,000 was issued, and on Friday not less than $2,150,000, making the amount outstanding on Friday, July 28, at 3 P. M., $25,400,000, the largest amount outstanding during the present crisis.

The gold coin paid out for clearing-house balances by the Sub-Treasury has already had its effect in increased receipts by the Custom House. During the last two weeks the in and out movement from and to the Sub-Treasury has been as follows:

Week ending—	In.	Out.
July 21	480,000	3,780,000
" 28	895,000	3,870,000
Total	1,375,000	7,650,000

This shows a balance against the government of $6,275,000, but it has caused a partial return of confidence worth twice the amount. If, as we suspect, Messrs. Jordan and Muhleman are responsible for this move, they are entitled to the thanks of the financial community.

Speaking of English investors coming in to hold up the New York market, the London "Financial News" says: When even the Vanderbilt influence and the Vanderbilt money cannot prevent Lake Shore from falling $4 in a day, and when Chicago millionaires, in all the pride of their World's Fair, cannot or will not step in to prevent Milwaukees being sold down $5 in a day, it is vain to look to European investors to come to the rescue. If the Americans cannot support their own stocks, they will have to go unsupported; and it will be difficult to tell where the decline will end. This is the most serious feature in the situation.

The foolish remarks of Gov. Waite, of Colorado, have caused much harm not only to silver but to the people of Colorado. The run on the Denver banks was more largely due to this than to any other cause. And it utterly failed of any useful effect. It certainly did not scare either the East or Europe. The latest comment on it, made by the "Financial News," of London, is as follows: "In Colorado, at least, the silver question is becoming terribly serious. At a silver convention held in Denver yesterdy, Governor Waite, a Populist—whatever that may be—declared that 'if the money power should attempt to sustain its usurpation by a strong hand we shall meet that issue when it is forced upon us, for it is infinitely better that blood should flow to the horses' bridles than that our national liberties should be destroyed.' From which it would appear that silver conventions are held after dinner, or that the Local Veto is not in force in the Centennial State."

Domestic and Foreign Coins.

The following are the latest market quotations for the leading foreign coins:

	Bid.	Asked.
Mexican dollars	$.58	$.59
Peruvian soles and Chilian pesos	.52½	.54
Victoria sovereigns	4.87	4.88
Twenty francs	3.86	3.89
Twenty marks	4.74	4.78
Spanish 25 pesetas	4.75	4.80

Things were bad enough when last we went to press, but during the week now closing they have been much worse, the climax seeming to have been reached last Wednesday, when things certainly went to "smash." Since then the feeling in Wall street has been rather better, but there is still the same extreme difficulty in securing money The high rates must have a very bad effect on all trades, and particularly that in metals of all descriptions for a long time to come, as it will, of necessity, restrict purchases to what is actually required from day to day.

Copper.—For this metal there is here practically no market, as the few small orders, which are being booked at 10¼@⅜ for lake, 9¾@10c. for electrolytic and 9⅝@¾ for casting, that are in the market, are hardly worthy of mention. Holders have had for some time past to look for a market in Europe, and they have placed such large quantities there that first the price of electrolytic, and now that of lake, suffered, the sales of the latter actually reported being at very low figures. Shipments from this side continue to be enormous, and while Europe has up to now stood the strain well, this cannot continue to be the case.

In England speculative prices have been pretty well maintained, and although on one or two days G. M. B.'s weakened, the loss has been about recovered, and, as last week, the close is steady at £42 7s. 6d. for spot and ten shillings higher for three months prompt. Refined and manufactured we quote as follows: English tough, £46@£46 10s.; best selected, £47 5s.@£48; strong sheets, £53 10s.@£54; India sheets, £52@£52 10s.; yellow metal sheets, £4 3s. 4d. The Indian demand is said to be very light indeed.

The exports of copper from the port of New York during the past week were as follows:

Copper matte:				
Liverpool—Arizona	3,797 bags	406,879 lbs.		$18,000
" "	6 casks	4,914	"	2,457
" Cufic	3,814 bags	401,580	"	18,000
" Adriatic	3,137 "	462,753	"	32,000
" Nasmyth	3,023 "	322,850	"	14,000
" Servia	2,348 "	277,293	"	12,500
" "	6 casks	6,000	"	3,000
Swansea—Massasoit	169 "	234,058	"	10,000
Copper:				
Liverpool—Adriatic	45 casks	58,250	"	5,536
" "	1 box silicon copper	604	"	169
" Nasmyth	45 casks	56,250	"	5,600
" Servia	708 pigs	161,180	"	16,000
" "	45 casks, 708 pigs	58,250	"	5,537
Bristol—Boston City	397 bars	114,443	"	10,586
" "	747 pigs	221,063	"	22,000
Swansea—Massasoit	768 bars	221,403	"	20,480
Hamburg—Rugia	481 casks	89,838*	"	10,100
Rotterdam—Rotterdam	328 bars	44,838	"	4,800
Gibraltar—Wesser	20 bbls.	25,000	"	2,688
London—Mohawk	2 casks	2,730	"	280
" "	827 pigs	172,408	"	17,000
Havre—La Touraine	135 casks	168,750	"	18,500
Bordeaux—Chateau Lafite	2,633 plates	168,951	"	17,890
" "	60 casks	53,760	"	5,900
" "	3,340 bars	200,402	"	21,550

Tin.—Early in the week the market was rather weak and sales were made at 18¾ for spot; later a decidedly better feeling was manifested and with a continued good demand from the interior prices hardened, closing at 19⅛@¼ for spot and early August, and 19⅝@⅝ for September. Stocks are now perceptibly decreasing.

The steady prices for silver made the bears in London rather nervous, and their covering in the open market, as well as at the Banca sale, has resulted in a very much better tone, and, as in addition to this, it is feared that the Siamese troubles may interfere with shipments from the East, prices show a material gain, closing at £3 10s. for spot, and £82 15s. for three months, prompt.

Lead has been pressed for sale by the Western producers, no doubt because of the stringency in the money market. The official price has gone down to 3·30@3·35 after sales were made at 3·40@3·45 early in the week. While the market is very nervous and unable to withstand any pressure, it is, on the other hand, very difficult to secure large quantities of the metal at present quoted prices. To us it looks as if the considerable reduction in production which must occur right along, from now on, would be felt and prices advance in consequence.

The depression which we last week reported as existing in England was not of long duration, for as soon as a few sales had been made at £9 12s. 6d. a much firmer feeling was manifested and prices rapidly advanced to £10@£10 2s. 6d. for Spanish, with English quoted 2s. 6d. higher, the demand at these figures being very good.

St. Louis Lead Market.—The John Wahl Commission Company telegraph as follows: "Leads lower than ever and prices seem no longer any incentive to buyers. As low as 3·15c. has been named by sellers and no buyers found. The situation is very unsettled and next to impossible to give accurate quotations."

Spelter.—The dullness grows greater, from month to month, prices continually declining, a feature which is readily accounted for by the bad condition of the galvanizing business which it is said has resulted in a very large concern at Middletown, Pa., going into receiver's hands and the slackness of the demand from the brass makers. Even the strike in the Western coal sections, resulting in a curtailment of the spelter production of at least a third, has not stayed the decline, and we have to quote the market as nominal at 4c. New York.

The foreign market is about steady at £17 12s. 6d. for good ordinaries and at about 2s. 6d. higher for specials.

Antimony is still at the prices last reported.

Nickel. We hear of no transactions in this article.

IRON MARKET REVIEW.

NEW YORK, Friday Evening, July 28, 1893.

Pig Iron Production.

Fuel used.	Week ending July 28, 1892.	Week ending July 28, 1893.		From Jan., '92	From Jan., '93.
Anthracite.	74	32,000	64	28,860	1,059,699	1,010,674
Coke	140	127,700	125	121,370	4,066,069	3,955,724
Charcoal	42	10,700	36	7,845	292,715	266,620
Totals	256	169,700	225	158,025	5,418,483	5,233,018

The table here presented of the pig iron production of the United States has been corrected, making it accord with the official figures of production for the first six months of the year, issued by the Bulletin of the American Iron and Steel Association. The weekly figures are necessarily estimated to some extent, and a correction is needed when the half-yearly reports are received.

Pig Iron.—The iron trade is more than dull; for the time being it is dead, and this is true not only in New York, but substantially so of the trade throughout the country. Prices apparently hold firm, but there is not the slightest doubt that these are being cut to an unusual degree whenever the possibility of a cash sale presents itself. Restriction in production continues, and many furnaces are idle, a position forced upon them by the stringency of the money market, and consequent inability to meet pay rolls. It is a trite saying that when stocks accumulate, pay rolls have to be met with borrowed money. As money cannot now be had, furnaces shut down and stocks decrease. Ordinarily a decrease in stocks means an increase in business, but at present it means just the opposite. The workmen, too, are foolishly aiding to bring about bad times by standing out for the scale of wages. At present both men and employers should give and take, and both will suffer unless they do, the workmen more than their employers. Times are hard and money scarce, and it is an old saying that half a loaf is better than no bread. The man who voluntarily throws up a job now will meet with but little sympathy in his hour of need.

Pig iron quotations at New York may be put about as follows for Northern brands: No. 1, $14.50@$15; No. 2, $13.75@$14.50; gray forge, $12.25@$12.50. For Southern iron we quote: No. 1, $13.75@$14.75; No. 2 F., $12.75@$13.50; No. 1 soft F., $12.25@$14; gray forge, $11.75@$12.50—all at tidewater. Scotch irons are quoted: Coltness, $21.50@$22; Eglinton, $19.50@$20; Summerlee, $20.

Billets and Rods.—There is no demand of consequence. We quote: Steel billets, tidewater, $23.50@$24.50; foreign, $28.50@$29; wire rods, $31.50@$32; foreign, $40@$40.50; Swedish, $52@$53.

Manufactured Iron and Steel.—Local business continues weak. Prices continue low and un-

changed. We quote: Angles, 1·75@2c.; axles, scrap, 1·90@2·10c., delivered; steel, 1·85 @2c.; bars, common, 1·50@1·60c.; refined, 1·65@1·9c. on dock; beams, up to 15 in., 1·80@2c.; 20 in., 2·10 @2·30c.; car truck channels, 2@2·10c.; channels, 1·90 @2·10c. on dock; hoops steel, 1·8@1·9c., delivered; links and pins, 1·85@2·10c.; plates, flange, 2@2·10c.; firebox, 2·5@2·8c.; flange, 2·10@2·25c.; marine, 2·50@ 2·75c.; sheared, 1·85@2·10c.; shell, 1·95@2·10c.; tank 1·75@1·9J; universal mill, 1·80@1·90c.; tees, 1·95@ 15c., all on dock.

Merchant Steel.—The market continues dull. Quotations are: Tool steel, 6·50@6·75c. and upward; tire steel, 2@2·10c.; toe calk, 2·20@2·30c.; Bessemer machinery, 2·10@2·20c.; Bessemer bars, 1·80@2c.; open hearth machinery, 2·20c.; open hearth carriage spring, 2·10@2·20c.; crucible spring, 3·75@4c.

Old Material.—The few buyers in the field get all the scrap needed at their own prices. Quotations, in the absence of sales on which to base them, are nominally as follows: Old iron rails $15.50@$16; steel rails, $11.50@$13; car wheels, $11.50@$13.50.

Rail Fastenings.—The market for rail fastenings continues lifeless. Quotations remain: Fish and angle plates, 1·55@1·60c. at mill; spikes, 1·9@1·95c.; bolts and square nuts, 2·45@2·50c.; hexagonal nuts, 2·55@2·60c., delivered.

Spiegeleisen and Ferromanganese. — As reported in our last issue there is no demand and we have no sales to report. Quotations are nominally as follows: 10 to 12% Spiegel $22@$22.50, 20% $25@ $25 50; Ferro, $56@$57.

Steel Rails.—Only one or two small sales of standard sections for the week. The market continues very dull. Quotations are unchanged at $29 mill or tidewater. Girder rails, $31@$33. Steel rails fit to relay can be had for $19@$20.

Tubes and Pipe.—Business in tubes and pipes continues quiet. Ruling discounts on carload lots are as follows: Butt, black, 57½, 10 and 5%; butt, galvanized, 50, 10 and 5%; lap, black, 67½, 10 and 5%; lap, galvanized, 57½, 10 and 5%.

NOTES OF THE WEEK.

According to the semi-annual report of the "Bulletin" of the American Iron and Steel Association the stocks of pig iron on hand July 1st, 1893, compared with former periods are as follows.

	July 1, 1892.	Sept. 30, 1892.	Dec 31, 1892.	July 1, 1893.
Bituminous	345,196	290,509	213,615	244,144
Anthracite	173,935	133,120	119,015	120.461
Charcoal	218,812	193,753	173,486	184,536
Totals	737,946	617,382	506,116	549,141

The rod, wire and nail mills of the Carnegie Steel Company at Beaver Falls have closed down for repairs.

The iron and steel plant of Jones & Laughlin at Pittsburg resumed in all departments July 24 after an idleness of several weeks. The steel, iron and finishers' scales of the Amalgamation Association were all signed. In the case of the finishers all have returned to work but President Carey, of the Finishers' Union, who resigned because his union was not recognized. The resumption gives employment to 5,000 men.

The American Iron and Steel Association has received from the manufacturers complete statistics of the production of Bessemer steel ingots and Bessemer steel rails in the United States in the first half of 1893. These statistics show a remarkable uniformity in the production of both ingots and rails in the first and second halves of 1892 and the first half of 1893.

The following table gives, in gross tons, the production of Bessemer steel ingots in the first half of 1893, compared with the first half and second half of 1892. In the figures for the periods mentioned are included the production of ingots by the Clapp-Griffiths works and Robert-Bessemer works.

States–Ingots.	First half 1892. Gr. tons.	Second half 1892. Gr. tons.	Total 1892. Gr. tons.	First half 1893. Gr. tons.
Pennsylvania	1,218,504	1,179,480	2,397,984	1,337,079
Illinois	437,067	442.885	879,952	220,059
Ohio	200,946	208,909	409,855	232,980
Other States	202,411	278,233	480,644	301,939
Totals	2,058,928	2,109,507	4,168,435	2,092,057
Clapp-Griffiths	36,971	37,744	74,718	37,013

The following table gives, in gross tons, the production of Bessemer steel rails of all weights and sections, including street rails, in the first half of 1893, compared with the first half and second half of 1892. In this statement is not included a few thousand tons of Bessemer steel rails which were rolled from purchased blooms.

States—Rails.	First half 1892. Gr. tons.	Second half 1892. Gr. tons.	Total 1892. Gr. tons.	First half 1893. Gr. tons.
Pennsylvania	474,018	411,634	885,652	429,059
Illinois	240,925	209,617	450,542	170,263
Other States	57,493	65,045	122,538	104,918
Totals	772,436	686,296	1,458,732	704,240

Buffalo. July 27.

(Special Report of Rogers, Brown & Co.)

Demand for iron is of the hand-to-mouth nature, with a further curtailment in the amount of business doing. While production is apparently falling off faster than consumption, there is enough offering to supply all needs. Prices have held steady during the week, and a growing sentiment is apparent among buyers that it is a favorable opportunity for buying in anticipation of the future if in a position to do so.

We quote for cash f. o. b. cars Buffalo: No. 1 X foundry strong coke iron, Lake Superior ore, $14; No. 2 X foundry strong coke iron, Lake Superior ore, $13.25; Ohio strong softener No. 1, $14; Ohio strong softener No. 2, $13.25; Jackson County silvery No. 1, $17@$17.30; Jackson County silvery No. 2, $16 30@ $16.80; Lake Superior charcoal, $16; Tennessee charcoal, $16; Southern soft No. 1, $13.65; Alabama car wheel, $18; Hanging Rock charcoal, $20.50.

Chicago. July 27.

(From our Special Correspondent.)

The discouraging aspect at present and the dubious outlook for the near future force also manufacturers of crude and finished iron to admit that the chance for improvement is exceedingly slight. Apparently the only hopeful feature is in good crops, which are now fairly well assured, so that even at the current low prices of grain and other products, the prospects for a late fall trade are more propitious than they were. At this writing the implement makers appear to be the only consumers who are interesting themselves in iron and steel for future delivery. The iron trade as a whole was quieter last week than the preceding one, and purchases in all lines were restricted to actual requirements, which are light.

Pig Iron.—Many foundries which usually have an abundance of work have found it necessary during the past few days to cut down their working forces, and some of the smaller ones have suspended operations altogether until business improves. There is less buying this week than there was a week ago, and the feature of the trade in local coke iron is carload orders. Outside of that there is little doing. Liquidation is still going on, and until there is a restoration of confidence the hand-to-mouth policy will continue. Southern coke iron is moving very quietly, and good cash purchasers can secure bargains in all grades. Lake Superior charcoal iron, though still inactive, is in better shape, as the several low-priced lots ($14) which had been offered to consumers have been withdrawn. There are only a few furnaces making this grade of iron now in blast, as the margin is too small, and adventitious circumstances have forced manufacturers to cease operations.

Quotations per gross ton f. o. b. Chicago are: Lake Superior charcoal, $16.00@$16.50; Lake Superior coke, No. 1, $13.50@$13.75; No. 2, $12.75@$13.25; No. 3, $12.25@$12.50; Lake Superior Bessemer, $14.00; Lake Superior Scotch, $14.50@$15; American Scotch, $15.50@$16.50; Southern coke, foundry, No. 1, $14.00; No. 2, $12.35; No. 3, $12.00; Southern coke soft, No. 1, $12.75; No. 2, $12.50; Ohio silveries, No. 1, $16.50; No. 2, $16.00; Ohio strong softeners, No. 1, $16.25; No. 2, $16.00; Tennessee charcoal, No. 1, $17; No. 2, $16.50; Southern standard car wheel, $18.50@$19.

Structural Iron and Steel.—New business of any kind is exceedingly light, and specifications which had been out have been withdrawn for a season. Quotations, car lots, f. o. b. Chicago, are as follows: Angles, $1.75@$1.85; tees, $1.95@ $2.05; universal plates, $1.75@$1.85; sheared plates, 75c.@$1.85; beams and channels, $1.80@$1.90.

Plates.—There is evidence that quite a large tonnage is being held back until later in the year. Business at present, in carloads or from warehouses, is very light, and prices, though weak, are unchanged. Steel sheets, 10 to 14, $2.25@$2.35; iron sheets, 10 to 14, $2.20@$2.30; tank steel, $1.90@$2; shell iron or steel, $2.50@$2.75; firebox steel, $4.25@$5.25; flange steel, $2.74@$3; boiler rivets, $4@$4.15; boiler tubes, all sizes, 65%.

Merchant Steel.—Several contracts for plow steels were secured this week and implement makers continue to ask prices covering their supplies for the season. Orders for prompt shipment are very limited. Tool steel is dull. Quotations are: Tool steel, $6.50@$6.75 and upward; tire steel, $2@$2.10; toe calk, $2.30@$2.40. Bessemer machinery, $2.10@$2.20; Bessemer bars, $1.60@$1.70; open hearth machinery, $2.25@$2.30; open hearth carriage spring, $2.10@$2.20; crucible spring, $3.75@$4.

Galvanized Sheet Iron.—Mill and warehouse orders are confined to actual requirements of consumers, and the tonnage entered in July is fully two-thirds less than for the same month last year. Discounts are easy at 70, 10 and 5% off on Juniata and 70, 10 and 10% off on charcoal, and jobbing quantities at 70 and 7½% off on the former and 70 and 10% off on the latter.

Black Sheet Iron.—Orders of any size are conspicuous by their absence, even carloads are rare and prices unchanged at 2·85c. for No. 27 common, and 2·90@2·95c. for steel. Jobbers quote 3c. for iron and 3·10@3·15c., for steel, same gauge.

Bar Iron.—As to the usual contracting done at this season for scattered delivery through the year there is little being closed; consumers and mill men are content to wait the outcome of the severe course of liquidation now in progress. Such orders as do crop out are for a small tonnage and immediate delivery. Regular quotations are 1·45c.@1·50c., base, 60 days, 2% for cash, to best buyers. Warehouse trade is more moderate at 1·65@1·75c. for iron and steel bars.

Nails.—Wire nails are in some demand in 500 to 1,000 keg lots at $1.40, but mill agents complain of light business. Jobbers quote $1.55 from stock. Steel cut nails are very slow and mill price easy at $1.20. Jobbers quote $1.35 and orders very light.

Steel Rails.—There is very little in the situation to build up any hopes of speedy revival, but rails are certainly not feeling the same amount of depression so noticeable in other products of iron and steel. Orders are restricted to positive wants and prices are unchanged at $30@$31.

Scrap.—Business in any kind of scrap is perfectly lifeless, either as regards selling or buying, and quotations are nominal. Railroad, $13.50; No. 1 forge, $12; No. 1 mill, $9.00; fish plates, $14.50; cast borings, $5.00; wrought turnings, $7.50; axle turnings, $9.25; machinery castings, $10; stove plates, $7.50; mixed steel, $9; coil steel, $15; leaf steel, $15; tires, $14.50.

Old Material.—Iron rails would probably fetch $15.75@$16 if there was any demand. Old steel rails are very dull at $10@$13, according to condition and length. Car wheels nominal at $14.

Philadelphia. July 28.

(From our Special Correspondent.)

Pig Iron.—It seems impossible to discover anything deserving of note in the pig iron market. It is well, however, to know that there is no unfavorable change. Prices for all kinds of crude iron are firm. A week or two ago, it was thought that a sharp shading would be made on ordinary brands, of which there is a good supply offering; but the parties having the iron, after a pretty thorough canvass, discovered that no business was to be done, even at concessions which would give them no profit whatever; hence they decided this week to make no more effort to do business. The average quotation for No. 1 foundry is $15@$15.25; No. 2, $14.50; forge, $12.75. There is more inquiry for Bessemer, but the parties seem to want iron for less than cost, and no business is reported.

Steel Billets.—There are parties now in the market trying to buy. Sellers are offering billets at $24; buyers are not willing to pay over $23. Their necessities are not very urgent at present, and they believe that by September 1st more favorable terms will be obtainable.

Muck Bars.—Not a single important order has been heard of. The asking price is $23, but $22.50 has been offered for several lots. Nothing, however, has been sold at that price.

Merchant Iron.—There is a possibility of considerable business being done in a short time in merchant bars, as consumers are very low in stocks. The car builders are now in the market, and will probably place several large orders early in August. Quotations run from 1·55 for common at interior mills, up to 1·70.

Skelp.—Sheared skelp is quoted 1·60, but there is none selling at that figure.

Wrought Iron Pipe.—Very little business is done in pipes, though in tubes a great deal of new work has just been secured.

Sheet Iron.—The mills have started up, all on orders, but they are for small quantities. Some large sales have been effected at Western mills.

Plate and Tank.—Manufacturers report only small orders coming to hand this week. They intimate that there is big work in sight, but none of it is likely to be placed for two or three weeks to come.

Structural Material.—A number of orders for office building and warehouse work are promised for next week. Prices are very irregular on new work in sight. Some sharp bidding is being done, but there is no probability of an early revival of trade. Universal plates are quoted at 1·70; beams, tees and channels, 1·80.

Steel Rails.—Very little business has been done in light sections, but the rail makers say that there are at last some signs of a general improvement in rail orders. Standard sections are quoted, as usual, at $29.

Old Rails.—Old iron rails are offered freely at $16, without much business resulting.

Pittsburg. July 28.

(From Our Special Correspondent.)

Iron and Steel.—The market for all kinds of iron and steel continues in an unsettled condition with business to the smallest possible proportions, and with prices weak and irregular for manufactured products, but displaying a little more firmness for crude iron. The heavy decline in the output of pig iron, which was such a marked feature of the trade during the past month, and which has continued into the present month, places that branch of the iron business in a more satisfactory condition to take advantage of a change for the better.

Producers find the market a little more in their favor than it has been any time during the year, although with the limited demand this factor argues better for the future than for the present. Outside of a few lots here and there, which have been cleared out by parties desiring to obtain ready cash, there is no disposition to force matters by concessions in quoted rates. The furnace men insist that good iron cannot be sold any lower than now quoted, but

the general sentiment seems to be that the low price of ore and coke will enable furnaces to make iron cheaper than ever before, and that there is more probability of a decline in prices than an advance. It is a matter of surprise how little business there is around, and how little interest is manifested in regard to prices. The chief concern is to get money to meet engagements and to incur as few liabilities as possible, new business, unless with prompt cash attached to it, being of secondary importance. Work at the mills, therefore, is being conducted on a smaller scale than for years with buc little prospect of improvement in the very near future.

Prices are getting down to a point which seems almost incredible, but low prices are evidently not the panacea for present condition. Ultimately things will work out all right, but in the meanwhile the outlook is not encouraging, and it is to be feared that the fall and winter months will be the dullest experienced for a long time past.

Coke Smelted Lake and Native Ore.

Tons.	Cash.
1,000 Bessemer, July, August	$13.15
1,000 Bessemer, July, August	13.30
1,000 Bessemer, prompt, Valley Iron	13.25
1,000 Bessemer, City furnace	13.40
1,000 Gray Forge, July, August	12.00
500 Bessemer, prompt	13.20
500 Gray Forge	12.15
200 No. 2 Foundry, at V. furnace	12.00
150 Off Bessemer	12 75
100 No. 1 Foundry	14.00
100 No. 2 Foundry	13.00

Blooms, Billets and Slabs

Tons.	Cash.
2,000 B. & S., Aug., Sept., Oct., at works	$21.15
1,000 B., Aug., Sept., at works	21.25
1,000 B., Aug., Sept., Oct., at works	21.20
500 B., spot, at works	21.50
300 B., Aug., at works	21.30

Charcoal.

100 Cold Blast	26.50
100 Cold Blast	26.00
75 Cold Blast	24.00
75 No. 2 Foundry	18.50
50 No. 2 Foundry	18.80

Muck Bar.

500 Neutral	21.80
200 Neutral	21.80
100 Neutral	21.90

Skelp Iron.

380 Narrow gr'v'd	140 4m.
320 Wide grooved	140 4m.
200 Sheared	150 4m.

Skelp Steel.

350 Wide Gr'v'd	140 4m.

Sheet Bars.

1,500 July, Aug., Sept., at mill	27.00

Ferro-Manganese

200 80% Domestic	$58.00
30 80% Domestic	58.50

Scrap Material

1,000 No. 1 R. R. W. Scrap, July, Aug., net	13.00
400 R. R. scrap, gross	11.00
300 R. R. leaf steel, July, Aug., gross	19.50
200 Gray mixed steel, July, Aug., net	13.00

COAL TRADE REVIEW.

NEW YORK, Friday Evening, July 28.

Statement of shipments of anthracite coal (approximated) for week ending July 22nd, 1893, compared with the corresponding period last year:

	July 22, 1893. Tons.	July 23. 1892. Tons.	Difference.
Wyoming region	458,317	485.343	Dec. 27 026
Lehigh region	133.364	121,916	Inc. 11,448
Schuylkill region	193,399	249,471	Dec. 56,672
Totals	785,080	856,730	Dec. 71,650
Total for year to date	23,398,896	22,111,260	Inc. 1,287,636

PRODUCTION OF BITUMINOUS COAL for week ending July 22nd and year from January 1st:

Shipped East and North:	1893. Week.	1893. Year.	1892. Year.
Phila. & Erie R. R.	2,434	50,596	48,540
Cumberland, Md.	84,826	2,245,112	2,025,077
Barclay, Pa.	672	33,980	111,181
Broad Top, Pa.	7,037	374,587	319,172
Clearfield, Pa.	69,278	2,334,680	2,229,022
Allegheny, Pa.	22,482	720 953	695.687
Beach Creek, Pa.	26.233	896,479	1,399.717
Pocahontas Flat Top	43,273	1,605,597	1,234,058
Kanawha, W. Va.	63,656	1,751,030	1,328,085
Total	319,951	10,013,014	9,450,539

Shipped West:	1893. Week.	1893. Year.	1892. Year.
Pittsburg, Pa.	23.055	724,688	723,046
Westmoreland, Pa.	32,842	1,125,392	917,134
Monongahela, Pa.	12,933	424,996	330,082
Totals	68,830	2,279,076	1,970,262
Grand totals	388,781	12,292,090	11,420,801

PRODUCTION OF COKE on line of Pennsylvania R. R. for the week ending July 22nd, 1893, and year from January 1st, in tons of 2,000 lbs.: Week, 62,538 tons; year 2,937,411 tons; to corresponding date in 1892, 3,081,599 tons.

Anthracite.

The stringency of the money market and resulting financial depression are now showing their effects upon the coal trade. Consumption has decreased and stocks increased. July circular rates have not been maintained, all reports to the contrary, except on small and insignificant orders. The Sales Agents at their June meeting adopted a schedule contrary to business principles and common sense. It was at the time explained by saying that the advance was necessary, owing to the reports that the Philadelphia & Reading Coal and Iron Company would be forced to sell their large stocks at auction, and that to prevent this disaster to the entire anthracite coal trade it was necessary to stiffen it by an advance in prices. Whether this action was or was not justified by the then existing condition of affairs it failed of its purpose, notwithstanding that the output was at the same time restricted to 3,000,000 tons. Stocks have accumulated, and at the meeting of the Sales Agents held Thursday, July 27, it was deemed necessary to again restrict the output, the amount allowed for August being 2,500,000 tons.

The schedule rates for August remain the same as those for July. It is reported that the meeting was entirely harmonious, and that a decrease in stocks is confidently expected. This sounds well, but it is pertinent to inquire how closely the companies will observe their allotment. Already there are some complaints that the July output has been exceeded. If this be so, how much more will this be true of the August allotment?

The Reading official circular rates are as follows, f. o. b. at its New York harbor shipping ports:

	Broken.	Egg.	Stove.	Chestnut.
Hard white ash	$4.00	$4.25	$4.60	$4.60
Free white ash	3.90	4.15	4.60	4.60
Shamokin	....	4.50	4.80	4 60
Schuylkill red ash	....	4.50	4.95	4.75
Lykens Valley	5.00	5.80	6.20	4.45

Pea, $2.50@2.75; No. 1 Buckwheat, $1.75@2; No. 2 Buckwheat, $1.50.

Pea and buckwheat are in good demand.

Rates at Port Richmond for shipment are 25c. per ton below these figures.

Bituminous.

During the week there have been numerous rumors of the cutting of prices upon the part of the principal companies. These rumors are extravagant, to say the least. There may have been a cut here and there for special business, and where spot orders were given the sellers may have yielded to the extent of five to ten cents per ton, but on the whole it is more than probable that the majority of the shipments have been made at schedule rates. As would naturally be expected, the shutting down of many mills in New England and the Middle States has caused a lessened demand for soft coal, which is reflected in prices. Consumers generally are working off stocks and living from hand to mouth.

We hear it reported that the New York, New Haven & Hartford Railroad and the Boston & Maine Railroad have placed their contracts for the season. These contracts were divided among several firms, and while the prices given are somewhat below schedule rates, they are above those paid by the same roads last year. We understand that Clearfield was sold at $2.20 at Philadlephia, and Pocahontas at $2.30 at Norfolk.

There has been a good deal of talk about shortage of orders. In answer to this several of the most prominent companies state that they have been asked to help out other companies by selling coal to them, which would indicate that some of the companies either have an abundance of orders or that owing to the prevailing scare they have restricted their output too far.

There is a slight blockade on the Pennsylvania Railroad owing to the fact that some shippers are not moving their coal promptly, causing a backing up of cars on the sidings. Vessels are in good supply and we quote as follows: Philadelphia to Boston, Salem, Portland and Portsmouth, 70c. alongside; 65c. to Sound ports, and 75c. to ice ports in Maine. Baltimore, Norfolk and Newport News 5c. higher than Philadelphia rates. There is a probability of a 5c. reduction from all ports.

Boston. July 27.

(From our Special Correspondent.)

In hard coal trade is of very limited proportions. There seems to be no desire on the part of the yard men to lay in new stock notwithstanding the fact that their present holdings are light. The companies, seeing no sense to forcing the market, are consequently not shading on prices, as its effect would simply be to demoralize the market.

The prices quoted here are those f. o. b. at New York on free burning coal: Stove, $4.45; egg, $4.00; free broken, $3.90: chestnut, $4.40. Lykens Valley (at Philadelphia), broken, $4.90; egg, $5.55; stove, $6.00; chestnut, $5.25.

The feature of the week in soft coal has been the closing of two large contracts for coal by the Boston & Maine Railroad Company and the New York, New Haven & Hartford Railroad Company. The first-named road closed for 300,000 tons, which is said to have been divided as follows: Pocahontas, 50 000 tons; Moshannon Creek, 50,000 tons; Big Vein, 25,000 tons; Cumberland, from 25,000 to 50,000 tons; mis-cellaneous Clearfields, 50,000 tons. All of these are to be tidewater shipment, but there is to be in addition from 75,000 to 100,000 tons of Reynoldsville, all-rail shipment. The latter coal is for the Connecticut River road and Western branches.

The New York, New Haven & Hartford closed for from 500,000 to 600,000 tons of bituminous. The companies with which it closed were the New River, Pocahontas, Clearfield and Cumberland. The Clearfield people are said to have secured about 150,000 tons, and the Pocahontas people about 100,000 tons. Of the total placed about 100,000 tons was for all-rail coal. The Old Colony railroad contract was not included in this total, notwithstanding the fact that it is now controlled by the New Haven road. It is said that the prices realized on these contracts were from 10c. to 15c. per ton higher than last year, which shows that the producing companies are maintaining their prices well. Coal on cars here is quoted as follows: Cumberland, $3.60; New River and Pocahontas, $3.52@$3.60: Clearfield, $3.25.

Freight Rates are somewhat lower owing to freer offerings From New York, 55@60c; from Philadelphia, 65@70c.; from Baltimore, 75c.; from Newport News and Norfolk, 60c.; to Sound Points, 50c.

In a retail way trade is of very moderate proportions and prices are steady. We quote: Stove, $6.25; nut, $6.25; egg, $6.00; furnace, $5.75; Franklin, $7.75; Lehigh egg, $6.25; Lehigh furnace, $6.00; soft coal, $4.25.

Buffalo. July 27.

(From our Special Correspondent.)

The anthracite coal market is without features worth noting, other than making record of the fact that lake freighting continues very dull and local trade equally quiescent. The bituminous business is moderately active for vessel use and fairly so for manufacturing purposes.

Prices of anthracite and bituminous are without change. The supply is fully adequate to all demands made upon stocks. The indications manifested at present are that the quotations of anthracite will be advanced August 1st. It may be that the railroad people may increase freight charges, but the general idea seems to be that this will not be done.

The shipments of coal by lake westward from Buffalo for the week ending July 22d were 63,420 net tons distributed as follows: 26,500 to Chicago, 11,850 to Milwaukee, 5,300 to Duluth, 4,300 to Superior, 800 to Green Bay, 500 to Kincardine, 720 to Detroit, 350 to Bay City, 1,000 to Sault Ste. Marie, 1,200 to Manitowoc, 4,600 to Toledo, 2,000 to Ashland, 2,200 to Gladstone, 900 to Saginaw, 400 to Menominee, 100 to Alpena and 700 to Racine. The rates of freight were 50c. to Chicago, Racine and Kincardine, 45c. to Milwaukee and Manitowoc; 40c. to Sault Ste. Marie, Port Huron, Saginaw and Menominee; 35c. to Bay City, and 30c. to Detroit, Ashland, Gladstone, Duluth, Superior and Toledo.

In consequence of a collision the "David Vance" was sunk off the mouth of the Detroit River last Wednesday, and about 1,600 tons of anthracite coal has gone from the visible supply of that commodity —it now lying about seven fathoms deep "under the waters cold," as the old song says. No lives lost.

Messrs. Loomis & Co. agreed to supply the anthracite coal for our schools and municipal buildings from the Wyoming district when they obtained the contract alluded to in last week's "Engineering and Mining Journal."

Chicago. July 27.

(From our Special Correspondent.)

There has been more inquiries for prices and more orders for anthracite coal from the country during the past few days than there have been since July 1, though it must be stated that the major portion of the business taken has been at June circular, and in some cases at May prices. There is some talk of stiffening up the market this week, but it is only on paper, and any dealer or purchaser can by personal application easily secure coal at June circular, at least. The recent failures in banking and commercial circles at Milwaukee are causing shippers to scrutinize more closely than usual their line of credits. The continued stringency in the money market all over the country renders careful attention to credits very wise and necessary, while at the same time it restricts the usual country business which should be done at this season.

The bids last week for hard coal for the Fire Department bear out our statement of a week ago as to weakness of prices of the retail trade in this city. The circular was cut 67c. per ton by parties who have no docks and receive no anthracite direct from the East, but are backed by one of the shippers who is evidently afraid to bid directly at such low figures. Receipts by lake and rail are much lighter.

Circular prices are at the following rates: Lehigh lump, $6.25; large egg, $5.85; small egg, range and chestnut, $6.10. Retail prices per ton are: Large egg, $6.75; small egg, range and chestnut, $6.75.

Bituminous coal is beginning to show a better inquiry from the West and Northwest. Indeed, the more or less interest developed during the early part of this week is decidedly encouraging to shippers and miners. The country demand is now fully up to the average of former years. The same cannot be said of steam coal, as so many factories are running on short time or closed down altogether that there is a notable decrease in the tonnage moving. Another reason for the comparative quietude is that large shippers and dealers are making no special efforts to sell coal of any kind; that is to say, they are not running after new business.

A fair trade is being done in Indiana block to the country, but there is a heavy falling off in the city steam trade. Prices on this grade, as also on best qualities of Illinois lump, are very steady, and the same may be said of Hocking, although that coal is rather quiet. As a result of the big coal failure in Milwaukee (Benjamin & Co.), the coal mines owned or controlled by them at North Creek and Clinton, Ind., have been closed down under attachment suits. West Virginia coal is being tried by some consumers, and so far is giving good satisfaction as a steam-raiser as compared with the lighter and cheaper coal of the West.

Prices of bituminous per ton of 2,000 lbs., f. o. b. Chicago, are: Pittsburg, $3.35; Hocking Valley $3.10; Youghiogheny, $3.25; Illinois block, $2.50; Brazil block, $2.50.

Coke is exceedingly quiet, and while there has been no serious break in the *straight* Connellsville fuel, prices are being shaded.

Quotations are: $4.65 furnace; $5.05 foundry, crushed; $5.40 Connellsville; West Virginia: $3.90 furnace, $4.10 foundry; New River Foundry, $4.65; Walston: $4.65 furnace, $5 foundry.

Pittsburg. July 27.

(From our Special Correspondent.)

Coal is a very difficult matter to write about just now. With the exception of 200,000 bushels in June there was no shipment since May 19th, over two months, by the Ohio River. The lower markets are reported badly in want of coal, with prices steadily going up. The prospect for a rise at present is a

slim one, but then the unexpected does happen sometimes. The pits in the pools are idle for the want of empties to load; their arrival depends on a rise in the Ohio. Railroad coal is being shipped daily to certain points. Prices are without change.

Connellsville Coke.—There is considerable mystery about the prices of coke. What it is quoted at is one thing; what it is selling at is another. Prices are about as uncertain as the New York stock market; you know what that is. The supply on hand exceds the demand; with the mills idle at nearly all points coke is not wanted to any extent. The price of coke workers is being reduced. A new scale has been introduced which provides a minimum basis of $1 per 100 bushels for mining, and 55 cents per 100 bushels for drawing coke, when the selling price of coke is $1.75 per ton.

Those operators who have cut the wage scale say it is impossible to pay it, and, rather than suspend, the reduction is offered. They argue this is a necessity of the situation and is only temporary. The McClure and H. C. Frick companies are paying the full scale.

Shipments for the week aggregate 96,255 tons, distributed in cars as follows: To Pittsburg, 1,675 cars; to points East, 1,340 cars; to points West, 2,050 cars; total, 5,065 cars. Western shipments increased 660 cars; Eastern, 190 cars, and Pittsburg 75 cars, making a net increase of 925 cars.

CHEMICALS AND MINERALS.

NEW YORK, Friday Evening, July 28.

Heavy Chemicals.—The market continues dull, but, on the whole, an increased inquiry for caustic soda is to be noted. Prices continue firm and agents are helping the trade as much as possible by holding goods and not forcing them on contract buyers. Prices are nominally quoted as follows: Caustic soda, 60%, 2·95@3·10c; 70%, 2 70@2·90c.; 74%, 2·72½@2·92½c.; 76%, 2·90@3·00c. Carbonated soda a·b, 48%, 1·25@1·30c.; 58%, 1·15@1·25c.; Alkali, 48%, $1.15@$1.20.; 58%, $1.10@$1.20, according to package. Sal soda, English, to arrive, 0·95c.; American ·95@1c.; bleaching powder, 2·25@2 37½c.; English United Alkali Association price, 2·50.

Acids.—There is no change in prices to report; prices continue firm and the demand is better than could be expected. We quote as follows: Acids, per 100 lbs. in New York and vicinity, in lots of 50 carboys or more: Acetic, in barrels, $1.87½; in carboys, $2.25; muriatic, 18°, 90c.@$1.10; 20°, $1@$1.25; 22°, $1.10@$1.35; nitric, 40°, $4; 42°, $4.50@$4.75; sulphuric, 90c.@$1.25. In the Connecticut valley, sulphuric, 66° B., is selling at 80c. flat. Mixed acids, according to mixture, oxalic, $6.30@$6.50. Blue vitriol is quoted all the way from $3.50 to $3.75; glycerine for nitro-glycerine, 11½@12½c., according to quality and quantity.

Brimstone.—Prices continue to break and we now quote $18 for best unmixed seconds, and $17 for thirds. There is no demand, but few sales, and the break in prices is hard to understand. It is apparently caused by the forced selling of old stocks.

Fertilizing Chemicals.—Buyers are still holding off, although there has been some further inquiry. There has been no changes in prices and we quote as follows: Dried blood, $2.20@$2.25 per unit for high grade, and $2.15 for low grade: azotine, $2.25@$2.30; sulphate of ammonia, $3.15 for gas liquor; bone liquor is offering at $3@$3.10. Concentrated phosphate (30% available phosphoric acid), 75c. per unit. Acid phosphate, 13% to 15%, av. P_2O_5 @60c. per unit at seller's works in bulk. Dissolved boneblack, 17% to 18%, P_2O_5@82·5 to 85c. per unit in bulk. Double superphosphate, 40% and above, soluble and 5% av., say, total of 48%, av. P_2O_5 @85c. per unit in bags. Acidulated fish scrap, no stocks on hand; dried scrap is quoted at $25 f. o. b. fish factory. Tankage, high grade, $25 50@$26; low grade, $24@$25. Bone tankage, $24@$25; bone meal, $24@$25.50.

The price of double manure salts as fixed by the syndicate is as follows: New York and Boston, $1.12; Philadelphia, $1.14½; Charleston and Savannah, $1.17 cwt., basis 48@50%, in 50 ton lots on foreign weights and analyses. Sulphate of potash, 90%-96%, basis 90%: New York and Boston, $2.07; Philadelphia, $2.09½; Charleston and Savannah, $2.12½, sulphate of potash, 96-99%, basis 90%, is 4% higher.

Phosphates.—Quotations for high grade land rock, f. o.b. Charleston are $4.50@$4.75. Freights are $2 25.

Muriate of Potash.—The market is quiet. The prices fixed by the syndicate for 1893 are as follows: New York or Boston, $1.78; Philadelphia, $1.80½; Southern ports, $1.83. During the past week 100 tons arrived, and about the same quantity was sold in small lots.

Kainit.—Practically nothing is doing in kainit. Quotations for shipments previous to September are as follows: New York, Philadelphia and Boston, $8.75 for foreign, invoice weight and test, and $9 for actual weight; Charleston, Savannah and Wilmington, $9.50 for invoice weight and test, and $9.75 for actual weight. Shipments after September 1st, 25c. higher.

Nitrate of Soda.—The nitrate market is dull, and prices have slightly fallen, without, however, any increase of business. Quotations are: $1.65 for goods on the spot and $1.70 for future, with no business to report in either.

Liverpool. July 19.

(Special Correspondence of Jos. P. Brunner & Co.)

A good deal of uneasiness is expressed here with reference to the coal crisis, as a strike on a large scale seems only too probable. The Alkali Company has issued notices to its men at the works intimating that it may have to close the works any time after the 24th inst., should it be unable to get supplies of fuel and salt. The prospect has not influenced chemicals to any great extent, except in the case of chloride of potash, which article is decidedly firmer.

Soda ash is slow of sale and quotations are unreliable, according to export market, quantity, make, etc. For Leblanc makes, nominal quotations are about as follows: Caustic Ash, 48%, £4 10s.@£5 per ton; 57 to 58%, £5 10s.@£5 15s. per ton net cash. Carb. Ash 48%, £4 15s.@£5 per ton; 58%, £5 5s.@£5 15s. per ton net cash. Ammonia Ash 58% is dull at £4 7s. 6d.@£4 10s. per ton, less 2½%.

Soda crystals are in fair request at £2 17s. 6d.@£3 per ton, less 5%.

Caustic soda is not active, but the demand is a little better of late. Quotations are nominally unchanged, varying considerably according to export market, and we quote spot range as follows: 60%, £8@£9 per ton; 70%, £9@£10 per ton; 74%, £10@£11 per ton; 76%, £11 10s.@£12 per ton net cash. For parcels under 10 tons, 5s. per ton extra is charged.

Bleaching powder is well maintained at £8 10s.@£8 15s. per ton net cash for hardwood casks.

Chlorate of potash is decidedly better, the weak resellers having been cleared out. A large business was done last week at low prices, but there are now no sellers for July delivery at 8d., while buyers offer 7¾d. For August, 8d. is asked, while 7½d. would probably buy. For July-December, business has been done lately at 7½d., but 7⅝@7¾d. is now asked.

Bicarb. of soda is in demand and firm at £6 15s. per ton, less 2½% for 1-cwt. kegs, with usual allowances for larger packages.

Sulphate of ammonia, although still scarce, is not so firm and £13 10s.@£13 12s. 6d. are about nearest values for good gray 24-25%, in double bags f. o. b. here, less 2½%.

Nitrate of soda is also a little off at £10 2s. 6d.@£10 5s. per ton, less 2½% for double bags f. o. b. here.

Carbonate of Ammonia.—Lump 3¼d. per lb powdered, 3½d. per lb.; less 2½%.

CURRENT PRICES.

These quotations are for wholesale lots in New York unless otherwise specified.

Acid—Acetic, chem. pure .17@.19
Commercial, in bbls. and cbys. .01¾@.12
Carbonic, liquefied, ℔ lb. .15@.25
Chromic, chem pure, ℔ lb 1.00
for batteries .40
Hydrobromic, dilute, U. S. P. .25@.30
Hydrocyanic, U. S. P. .45@.50
Hydrofluoric .20@.30
Alcohol—95%, ℔ gall. $2.30@$2.40
Absolute $3.80
Ammoniated $2.80
Alum—Lump, ℔ cwt. $1.75@$1.85
Ground, ℔ cwt. $1.85@$1.90
Powdered, ℔ lb. .04½@.05
Lump ℔ ton, Liverpool £5
Aluminum Chloride—Pure, ℔ lb. $1.25
Amalgamating solution, ℔ lb. .60
Sulphate, ℔ cwt $1.90@$2.50
Ammonia—Sal., in bbl. lots, ℔ lb. .07½@.08
Carbonate, ℔ lb., English and German, .07½@.08
Muriate, white, in bbls., ℔ lb. .08½
Aqua Ammonia—(in cbys) 3°℔ lb. .03@.04
20°, ℔ lb. .04@.05
26°, ℔ lb. .04¾@.05
Antimony—Oxymur, ℔ lb. .04@.06
Regulus, ℔ lb. .10@.11½
Argols—Red, powdered, ℔ lb. .15
Arsenic—White, powdered ℔ lb. .03@.03¾
Red ℔ lb. .065@.07
Yellow .08@.09
White at Plymouth, ℔ ton £12 2 6
Asbestos—Canadian, ℔ ton $50@$300
Italian, ℔ ton, c. i. f. L'pool £18@£60
Ashes—Pot, 1st sorts, ℔ lb. 4.75@5
Pearl .05½@.06¼
Asphaltum—
Prime Cuban, ℔ lb. .04@.05
Hard Cuban, ℔ ton $28.00@$30.00
Trinidad, refined, ℔ ton $30.00@$35.00
Egyptian and Syrian, ℔ lb. .05@.07½
Californian, at mine, ℔ ton $12.00@$26.00
at San Francisco, ℔ ton, $15.00@$29.00
Barium—Carbonate, pure, ℔ lb. .45
Carbonate, commercial, ℔ lb. .05@.10
Chlorate, crystal, ℔ lb. .75
Chloride, commercial, ℔ lb. .05@.10
pure, ℔ lb. .16
Iodide, ℔ oz. .40
Nitrate, ℔ lb. .06½@.07
Sulph., Am. prime white, ℔ ton $17.50@$19
Sulph., foreign, floated, ℔ ton $21@$24
Sulph., off color, ℔ ton $11.50@$15.00
Carb., lump, f. o. b. L'pool, ℔ ton £6
No. 1, Casks, Runcorn, " " £4 10 0
No. 2, bags, Runcorn, " " £3 15 0
Bauxite—℔ ton $10.00
Bichromate of Potash—Scotch, ℔ lb. .11@.12
American, ℔ lb. .11@.12
Bichromate of Soda—℔ lb. .09½@.10
Borax—Refined, ℔ lb., in car lots .08@.09
San Francisco .08@.08½
Concentrated, in car lots .07½@.08
Refined, Liverpool ℔ ton £2
Bromine—℔ lb. .25@.35
Cadmium Minion—℔ lb. $2.00
Cadmium Iodide—℔ lb. $5.50
Chalk—℔ ton $1.50@$2.25
Precipitated, ℔ lb. .04@.06
China Clay—English, ℔ ton $13@$18.00
Domestic, ℔ ton $9@$11
Chlorine Water—℔ lb. .10
Chrome Yellow—℔ lb. .10@.25
Chrome Iron Ore—℔ ton, San Francisco $10.00
Chromalum—Pure, ℔ lb. .35@.40
Commercial, ℔ lb. .02½
Cobalt—Oxide, ℔ lb $1.60@$1.70
Copper—Sulph. English Wks. ton £20@£21
Vitriol (blue), ordinary, ℔ lb. 03¼@.03¾
" extra .04½
Nitrate, ℔ lb. .40
Copperas—Common, ℔ 100 lbs. .85@.95
Best, ℔ 100 lbs. $1.35@$1.50
Liverpool, ℔ ton, in casks £2@£2 10s.
Corundum—Powdered, ℔ lb. .04½@.09
Flour, ℔ lb. .03
Cryolite—Pow., ℔ lb., bbl. lots .07@.08
Emery—Grain, ℔ lb. (℔ kg.) .04½@.05
Flour ℔ lb. .02½@.04
Epsom Salt—℔ lb. .01@.01⅛
Feldspar—Ground, ℔ ton $6.00@$10.00
Crude $2.00@$3 00
Fluorspar—Powdrd, No. 1, ℔ ton $20@$30
Lump, at mine $6@$8
French Chalk—
Fuller's Earth—Lump, ℔ ton $16@$20
Glauber's Salt—in bbls., ℔ lb. .01@.01¼
Glass—Ground, ℔ lb .09@.10
Gold—Chloride, pure, crystals, ℔ oz. $12.00
pure, 15 gr., c. v., ℔ doz. $5.40
liquid, 15 gr., g. s. v., ℔ doz. $5.50
Chloride and sodium, ℔ oz $6.00
15 gr., c.v., ℔ doz. $2.75
Oxide, ℔ oz. $27.25
Gypsum—Calcined, ℔ bbl. $1.25@$1.50
Land Plaster
Iodine—Resublimed, ℔ oz. .30@ 33
Iridium—Oxide ℔ lb. $90
Iron—Nitrate, 40°, ℔ lb .01@.01½
47°, ℔ lb .02@.02½
Kaolin—*See China Clay.*
Kieserite—℔ ton $9@$10
Lead—Red, American, ℔ lb .06¾@.07½
White, American, in oil, ℔ lb. .06½@.07½
White, English, ℔ lb., in oil .08½@.08¾
Acetate, or sugar of, white .06@.06½
Granulated
Nitrate .09@.12
Lime Acetate—Am. Brown .90@.95
" Gray $1.75@$1.87½
Litharge—Powdered, ℔ lb. .05½@.07½
English flake, ℔ lb. .06@.09½
Magnesite—Crude, ℔ ton of 1,015 kilos $14.75
Calcined, ℔ ton of 2,240 lbs. $22.00
Brick, ℔ ton of 2,240 lbs. $47.50
Manganese—Ore, per unit. .23@.28
Oxide, ground, ℔ lb .02½@.06½
Mercuric Chloride—(*Corrosive Sublimate*) ℔ lb. .62@.64
Powdered, ℔ lb. .5
Marble Dust—℔ bbl $1.25@$1.50
Metallic Paint—Brown ℔ ton. $20@$25
Red $20@$25
Mineral Wool—Ordinary slag .01½
Ordinary rock .02½
Ground, ℔ ton
Mica—In sheets according to size, 1st quality, ℔ lb. .25@$6.00
Naphtha—Black
Nitre Cake—℔ ton $10.00
Ochre—Rochelle, ℔ lb. .01¼@01¾
Washed Nat Oxf'rd, Lump, ℔ lb. 06½@.06¾
Washed Nat Oxf'rd, Powder, ℔ lb. 07@.07½
Golden, ℔ lb. .03@.05
Domestic, ℔ ton $12@$20
Oils, Mineral—
Cylinder, light filtered, ℔ gal. .14@.16
Dark filtered, ℔ gal. .10@.13
Extra cold test, ℔ gal. .20@.24
Dark steam refined, ℔ gal. .07½@.12
Phosphorus—℔ lb. .5 @.55
Precip., red, ℔ lb. .80@.85
white, ℔ lb. .85@.90
Platinic Chloride—Dry, ℔ oz $7
Plumbago—Ceylon, ℔ lb. .04@.05
American, ℔ lb. .05@ 07
Potassium—Cyanide, ℔ lb., C. P. .52
67%, ℔ lb. .0
mining .28@ 3
Bromide, domestic, ℔ lb. .28@ 32
Chlorate, English, ℔ lb. .18@.18¼
Chlorate, powdered, English, ℔ lb. .18½@.19
Carbonate, ℔ lb., by casks, 82% .04½@.05
Caustic, ℔ lb., pure slick .05½@.06
Iodide, ℔ lb. $2.50@$2.80
Nitrate, refined, ℔ lb. .06@.08
Bichromate, ℔ lb. .10@.11½
Yellow Prussiate, ℔ lb. .21½@ 22½
Red Prussiate, ℔ lb. .39@.4
Pumice Stone—Select lumps, ℔ lb 03½@.15
Original cks., ℔ lb. .01½@.02
Powdered, pure, ℔ lb. .01½@.01¾
Pyrites—Non-cupreous, p. units .12@.1
Quartz—Ground, ℔ ton $6.00@$10.00
Rotten Stone, Powdered, ℔ lb. .03¼@.03¾
Lump, ℔ lb. .06@.07
Original cks, ℔ lb. .04½@.05½
Rubbing stone, ℔ lb. .03½@.04
Sal Ammoniac—lump, in bbls., ℔ lb. .80½
Salt—Liverpool, ground, ℔ sack .70
Domestic, fine, ℔ ton $7@$7.50
Common, fine, ℔ ton $4.50@$4.75
Turk's Island, ℔ bush .26@.28
Salt Cake—℔ ton $10 00@$15.00
Saltpeter—Crude, ℔ lb. .03½@.04
Soapstone—Ground, ℔ ton $8@$
Block and slab according to size.
Sodium—Prussiate, ℔ lb. 22@.24
Phosphate, ℔ lb. .04@.05
Stannate, ℔ lb. .06@.12
Tungstate, ℔ lb. .30@.35
Hyposulphite, ℔ cwt., in casks $1.70@ $1.80
Strontium—Nitrate, ℔ lb. .08½@.09
Sulphur—Roll, ℔ lb. .01½@.0¾
Flour, ℔ lb. .01¾@.02
Sylvinit, 27@35%, S.O.P., per unit, 3.75
Talc—Ground French, ℔ lb. .01¼@.01½
American No. 1, ℔ lb. .01¼@.01½
American No. 2 .006
Terra Alba—French, ℔ lb. .65@.80
English, ℔ lb. .6 @.80
American, No. 1, ℔ lb. .60@.80
American, No. 2, ℔ lb. .40@.50
Tin—Crystals, in kegs or bbls. .14@.15
feathered or flossed. .20
Muriate, single .07@.12
Double or strong, 54° B. .10@.15
Oxymur, or nitro .19
Vermillion—Imp. English, ℔ lb. .80
Am. quicksilver, bulk .57 @.59
Am. quicksilver, bags .58 @.60
Chinese .85 @$1.00
Trieste .90 @.95
American .11½@.12
Zinc White—Am., Dry, ℔ lb 04½@.05
Antwerp, Red Seal, ℔ lb. .06¼@.07
Paris, Red Seal, ℔ lb. .07½@.08
Muriate solution .06
Sulphate crystals, in bbls., ℔ lb. .03@.03¾

THE RARER METALS.

Aluminum—℔ lb. .80@.85
Arsenic—(Metallic), per lb. .40
Barium—(Metallic), per gram .$4.00
Bismuth—(Metallic), per lb. $2.00
Cadmium—(Metallic), per lb. $1@$1.50
Calcium—(Metallic), per gram .$10.00
Cerium—(Metallic), per gram. $7.50
Chromium—(Metallic), per gram. $1.00
Cobalt—(Metallic), per lb. $6.00
Didymium—(Metallic), per gram. $9.00
Erbium—(Metallic), per gram. $7.50
Gallium—(Metallic), per gram .$140.00
Glucinum—(Metallic), per gram .$12.00
Indium—(Metallic), per gram. $9.00
Iridium—(Fused), per oz. $12.00
Lanthanum—(Metallic), per gr. .$10.00
Lithium—(Metallic), per gram .$10.00
Magnesium—(Powdered), per lb. $4.00
Manganese—(Metallic), per lb. $1.10
Chem. pure, per oz. $10.00
Molybdenum—(Metallic), per gm .50
Niobium—(Metallic), per gram. $5.00
Osmium—(Metallic), per oz. $65.00
Palladium—(Metallic), per oz. $20.00
Platinum—(Plate), per oz. $11.25
Potassium—(Metallic), per lb. $25.00
Rhodium—(Metallic), per gram. $5.00
Ruthenium—(Metallic), per gm. $5.50
Rubidium—(Metallic), per gram. $2.00
Selenium—(Metallic), per oz. $1.80
Sodium—(Metallic), per lb. 50@.75
Strontium—(Metallic), per gm. .60
Tantalium—(Metallic), per gram. $9.00
Telurium—(Metallic), per lb. $5.00
Thallium—(Metallic), per gram. .20
Titanium—(Metallic), per gram. $2.25
Thorium—(Metallic), per gram. $17.00
Tungsten—(Metallic), per lb. .8
Uranium—(Oxide), per lb. $5.00
Metallic, per gm. .60
Vanadium—(Metallic), per gm .$22.00
Yttrium—(Metallic), per gram $9.00
Zirconium—(Metallic), per oz $6.00

NEW YORK MINING STOCK QUOTATIONS.

DIVIDEND-PAYING MINES.

NAME AND LOCATION OF COMPANY.	July 22. H.	July 22. L.	July 24. H.	July 24. L.	July 25. H.	July 25. L.	July 26. H.	July 26. L.	July 27. H.	July 27. L.	July 28. H.	July 28. L.	SALES.
Adams, Colo.													
Alice, Mont.													
Amador, Cal.													
Atlantic, Mich.													
Belcher, Nev.													
Belle Isle, Nev.													
Bodie Cons., Cal.													
Bos. & Mont., Mont													
Breece, Colo.													
Buiwer, Cal.													
Caledonia, S. Dak.													
Catalpa, Colo.													
Chrysolite, Colo.													
Colorado Central, Colo.													
Commonwealth, Nev.													
Comstock T. bonds, Nev.													
" scrip., Nev.													
Cons. Cal. & Va., Nev.											1 20	1 10	100
Crown Point, Nev.													
Deadwood, Dak.													
Enterprise													
Eureka, Cons., Nev.													
Father de Smet, Dak.													
Freeland, Colo.													
Gould & Curry, Nev.													
Grand Prize, Nev.													
Hale & Norcross, Nev.													
Homestake, Dak.													
Horn-Silver, Utah.													
Independence, Nev.													
Iron Hill, Dak.													
Iron Silver, Colo.													
Leadville Cons., Colo.													
Little Chief, Colo.													
Martin White, Nev.													
Moulton, Mont.													
Mt. Diablo, Nev.													
Navajo, Nev.													
N. Belle Isle, Nev.													
Ontario, Utah.													
Ophir, Nev.													
Overman, Nev.													
Plymouth, Cal.													
Quicksilver, Pref., Cal.													
" Com., Cal.													
Quincy, Mich.													
Robinson Cons., Colo.													
Savage, Nev.													
Sierra Nevada, Nev.													
Silver Cord, Colo.													
Silver King, Ariz.													
Silver Min. of L. Valley													
Small Hopes, Colo.													
Standard Cons., Cal.													
Yellow Jacket, Nev.													

NON-DIVIDEND-PAYING MINES.

NAME AND LOCATION OF COMPANY.	July 22. H.	July 22. L.	July 24. H.	July 24. L.	July 25. H.	July 25. L.	July 26. H.	July 26. L.	July 27. H.	July 27. L.	July 28. H.	July 28. L.	SALES.
Alpha., Nev.													
Alta, Nev.													
American Flag, Colo.													
Andes, Cal.													
Astoria, Cal.													
Augusta, Ga.													
" bonds.													
Barcelona, Nev.													
Belmont, Cal.													
Best & Belcher, Nev.													
Bonanza King, Cal.													
Brunswick, Cal.													
Bullion, Nev.													
Butte & Bost., Mont.													
Castle Creek, Idaho.													
Challar.													
Comstock T., Nev.													
Con. Imperial, Nev.													
Con. Pacific, Cal.													
Crescent, Colo.													
Del Monte, Nev.													
El Cristo, Rep. of Col.													
Emmett, Colo													
Exchequer, Nev.													
Independence, Nev.													
Julia, Nev.													
Justice, Nev													
King & Pembroke													
Lacrosse, Colo.													
Lee Basin, Colo.													
Mexican, Nev.													
Minnesota Iron													
Monitor, Colo.													
Monte Cristo, Rep. of C.													
Nevada Queen, Nev.													
N. Standard, Cal.													
N. Commonwealth, Nev.													
Overman, Nev.													
Oriental & Miller, Nev.													
Phœnix Lead, Colo.													
Phœnix of Ariz.													
Potosi, Nev.													
Rappahannock, Va.													
S. Sebastian, S. Sal.													
Santiago.													
Scorpion, Nev.													
Seg. Belcher, Nev.													
Shoshone, Idaho.													
Silver Hill, Nev.													
Sullivan Con., Dak.													
Sutro Tunnel, Nev.													
Syndicate, Cal.													
Tornado Con., Nev.													
Union Cons., Nev.													
Utah. Nev.													

BOSTON MINING STOCK QUOTATIONS.

NAME OF COMPANY.	July 21.	July 22.	July 24.	July 25.	July 26.	July 27.	SALES.
Atlantic, Mich.					7.25		100
Bodie, Cal.							
Bonanza Development.							
Bost. & Mont., Mont.	17.00	16.50	17 00	17.50	17.25 17 00	16.00 16 13	15.50 16.00 15 75	2,677
Breece, Colo.							
Calumet & Hecla, Mich.	263	259	255	255	255	255	386
Catalpa, Colo.							
Central, Mich.							
Cœur d'Alene, Id.							
Con. Cal. & Va., Nev.							
Dunkin, Colo.							
Eureka, Nev.							
Franklin, Mich.	9.25				9.25	9.50 9.13	320
Honorine, Utah.							
Horn Silver, Utah.							
Kearsarge, Mich.	8 50				5 25	5 25	175
Lake Superior, Iron.							
Little Pittsburg, Colo.							
Minnesota Iron, Minn.							
Napa, Cal.			4.00				100
Ontario, Utah.							
Osceola, Mich.			23.00 22 50	23.00		23.50 22.00	22.50 21.50	835
Quincy, Mich.	87.00			85.00 83 00	87.00 85.00	82.00 80.00		118
Ridge, Mich.							
Sierra Nevada, Nev.							
Silver King, Ariz.							
Stormont, Utah.							
Tamarack, Mich.	130	127	128	127	128	125	127	123	120	112	113		389
Tecumseh, Mich.							

NAME OF COMPANY.	July 21.	July 22.	July 24.	July 25.	July 26.	July 27.	SAL
Allouez, Mich.							
Arnold, Mich.							
Aztec, Mich.							
Brunswick, Cal.							
Butte & Boston, Mont.					5.75	5 50 5.50	5 00	1,345
Centennial, Mich.	2.00	1.50		2.00	1.75	2.00	2 00	510
Colchis, N. Mex.							
Copper Falls, Mich.							
Crescent, Colo.							
Dana, Mich.							
Don Enrique, Mex.							
Geyser, Colo.							
Hanover, Mich.							
Humboldt, Mich.							
Hungarian, Mich.							
Huron, Mich.							
Mesnard, Mich.							
National, Mich.							
Native, Mich.							
Oriental & M., Nev.							
Phœnix, Ariz.							
Pontiac, Mich.							
Rappahannock, Va.							
Santa Fe, N. Mex.							
Shoshone, Idaho.							
South Side, Mich.							
Tamarack, Jr., Mich.							
Washington, Mich.							
Wolverine, Mich.							

Dividend shares sold, 5,081. Non-dividend shares sold, 1,845. Total shares sold, 6,926.

DIVIDEND-PAYING MINES.

	Name and Location of Company.	Capital Stock.	Shares. No.	Shares. Par	Assessments. Total levied.	Assessments. Date and amount of last	Dividends. Total paid.	Dividends. Date & amount of last.
1	Adams, s. L. C.	Colo..	$1,500,000	150,000	$10	*	$637,500	Jan.. 1892 .05
2	Alaska-Treadwell, g.	Al'ska	5,000,000	200,000	25		1,500,000	April 1893 .25
3	Alice, s.	Mont.	10,000,000	400,000	25	*	975,000	Nov.. 1891 .06½
4	Alma & Nel Wood., G	Idaho	300,000	30,000	10	*	60,000	Jan: 1889 .50
5	Amador, G.	Cal..	1,250,000	250,000	5	*	31,250	Aug.. 1890 .12½
6	American, G.	Colo..	3,000,000	300,000	10	*	225,000	Mar.. 1892 .05
7	American Belle, s. G. C	Colo.	2,000,000	400,000	5	*	50,000	April 1891 .12½
8	Americ'n & Nettie, G. &	Colo.		300,000			175,000	Mar.. 1892 .05
9	Atlantic, C.	Mich.	1,000,000	40,000	25	280,000 April 1875	$1.00	700,000 Feb.. 1891 1.00
10	Argenta, s.	Nev.	10,000,000	100,000	100	335,000 July. 1889	.10	40,000 Feb.. 1880 .20
11	Argyle, G.	Colo..	1,000,000	1,000,000	1	*		20,000 Mar. 1892 .01
12	Aspen Mg. & S., s. L.	Colo..	2,000,000	200,000	10	*		780,000 June 1893 .10
13	Aurora, I.	Mich..	2,500,000	100,000	25			650,000 Feb.. 1893 2.00
14	Badger, s	Ont..	250,000	50,000	5			37,500 Mar. 1890 .25
15	Bald Butte	Mont.	250,000	250,000	1	*		110,000 July. 1893 .02
16	Bates Hunter, s. g.	Colo..	1,000,000	1,000,000	1			Dec.. 1891 .00¾
17	Belle Isle, s.	Nev..	10,000,000	100,000	100	220 00 Aug.. 1892	.10	300,000 Dec.. 1879 .25
18	Belcher, s. G.	Nev..	10,400,000	104,000	100	3,16 000 May 1892	.25	15,397,000 April 1876 1.00
19	Bellevue, Idaho, s. L.	Idaho	1,250,000	125,000	10	1: 000 Dec.. 1889	.25	200,000 Jan.. 1890 .10
20	Best Friend.	Colo.	1,000,000	1,000,000	1			90,000 Feb.. 1892 .01
21	Bi-Metallic, s. G.	Mont.	5,000,000	200,000	25			2,300,000 April 1893 .20
22	Bodie Con., G. I.	Cal..	10,000,000	100,000	100	0,000 June 1890	.25	1,602,572 April 1885 .50
23	Boston & Mont., G.	Mont.	2,500,000	250,000	10	*		520,000 June 1886 .15
24	Boston & Mont., C. s.	Mont.	3,125,000	125,000	25	*		2,075,000 Nov.. 1891 1.00
25	Brooklyn Lead, L. s.	Utah.	500,000	50,000	10			127,000 July. 1887 .05
26	Brotherton, I.	Mich.	2,000,000	80,000	25	*		120,000 Mar.. 1893 .50
27	Bulwer, G.	Cal..	10,000,000	100,000	10	130,000 Aug.. 1889	.25	190,000 Oct.. 1892 .05½
28	Bunker Hill & S. s. L.	Idaho	3,000,000	300,000	10	*		150,000 Oct.. 1888 .06
29	Caledonia, G.	Dak..	10,000,000	100,000	100	505,000 May. 1885	.15	192,000 Oct.. 1890 .08½
30	Calliope, s.	Colo..	1,000,000	1,000,000				140,000 Jan.. 1891 .00
31	Calumet & Hecla, G	Mich..	2,500,000	100,000	25	1,200,000		39,350,000 May 1893 5 00
32	Centen'l-Eureka, s. L.	Utah.	1,500,000	30,000	50			675,000 June 1893 .50
33	Central, C.	Mich..	500,000	20,000	25	100,000 Oct.. 1861	.65	1,975,000 Feb.. 1891 1.00
34	Champion, G	Cali..	340,000	34,000	10			132,900 May. 1893 .10
35	Chrysolite, s. L.	Colo..	10,000,000	200,000	50	*		1,650,000 Dec.. 1884 .25
36	Clay County, G.	Colo..	200,000	200,000	1	*		56,000 Nov.. 1891 .02
37	Clinton Con, g.	Cal..	5,000,000	100,000	5			80,000 Nov.. 1891 .10
38	Cœur D'Alene, s. L.	Idaho	5,000,000	500,000	10			310,000 Nov.. 1891 .02
39	Colorado Central, s. L.	Colo..	2,750,000	275,000	10	*		530,000 April 1893 .05
40	Commonwealth, s.	Nev..	10,000,000	100,000	100	190,000 Sept. 1892	.10	20,000 Nov.. 1890 .20
41	Confidence, s. L.	Nev..	2,496,000	24,960	100	1,589,550 Aug.. 1892	.50	199,680 April 1889 1.00
42	Cons. Cal. & Va., s. G	Nev..	21,600,000	216,000	100	108,000 Jan.. 1885	.20	3,682,800 Aug. 1891 .50
43	Contention, s.	Ariz..	12,500,000	250,000	50			2,637,500 Aug. 1892 .20
44	Cook's Peak, s.	N. M..	2,000,000	200,000	10			114,532 Nov. 1892 .05
45	Cop. Queen Con., C.	Ariz..	2,000,000	200,000	10			1,460,000 May. 1893 .50
46	Coptis	Nev..	10,000,000	100,000	100			67,000 July. 1892 .12
47	Cortez, s.	Nev.	1,500,000	300,000	05	*		687,000 Mar.. 1892 .50
48	Crescent, s. L. G.	Utah.	15,000,000	600,000	25	60,000 Oct. 1892	.10	238,000 Oct.. 1888 .03
49	Crown Point, G. s.	Nev..	13,000,000	130,000	100	2,700,000 Sept. 1892	.25	11,898,000 Jan.. 1875 2.00
50	Cumberland, L. s.	Mont.	5,000,000	500,000	10	*		15,000 Nov.. 1889 .03
51	Daly, s. L.	Utah.	3,000,000	150,000	20			2,800,000 June 1893 .25
52	Deer Creek, s. G.	Idaho	1,000,000	200,000	5	*		20,000 June 1889 .05
53	Deadwood-Terra, G.	Dak..	5,000,000	200,000	25	*		1,150,000 Oct.. 1892 .05
54	Delamar, s. G.	Idaho	2,000,000	400,000	5			800,000 April 1893 .37½

NON-DIVIDEND-PAYING MINES.

	Name and Location of Company.	Capital Stock.	Shares. No.	Shares. Par	Assessments. Total levied.	Assessments. Date and am't of last.
1	Alliance, s. G.	Utah.	$100,000	100,000	$1	$120,000 Feb.. 1891 .2
2	Allouez, C.	Mich.	2,000,000	80,000	25	737,000 Jan.. 1890 .7
3	Alpha Con., G. s.	Nev..	3,000,000	30,000	100	209,000 Sept. 1892 .1
4	Alta, s.	Nev..	10,080,000	100,800	100	3,369,880 Jan. 1892 .1
5	American, C.	Idaho	5,000,000	500,000	100	
6	American Flag, s.	Colo..	1,250,000	125,000	1	300,000 June 1887
7	Amity, s.	Colo..	250,000	250,000	20	
8	Anchor, s. L. G.	Utah.	3,000,000	150,000	5	410,000 June 1890 .20
9	Anglo-Montana, Lt..	Mont.	600,000	120,000	125	
10	Appalachian, g.	N. C.	1,750,000	1,400,000	20	
11	Arizona, C.	Ariz..	3,575,000	160,000	2	
12	Astoria, G.	Cal..	200,000	100,000	5	
13	Atlanta, g. s.	Idaho	3,250,000	650,000	25	
14	Barcelona, G.	Nev..	5,000,000	200,000	5	*
15	Bear Creek	Idaho	100,000	20,000	1	
16	Belmont, G.	Cal..	500,000	500,000	100	*
17	Belmont, s.	Nev..	5,000,000	50,000	100	735,000 April 1886 .10
18	Best & Belcher, s. G.	Nev..	10,080,000	100,800	10	2,405,275 Aug.. 1892 .25
19	Black Oak, G.	Cal..	3,000,000	300,000	100	*
20	Boston Con., G.	Cal..	10,000,000	100,000	1	170,000 Nov.. 1883 .25
21	Brownlow, G.	Colo..	250,000	250,000	5	
22	Brunswick, G.	Cal..	2,000,000	400,000	2	
23	Buckeye, s. L.	Mont.	1,000,000	500,000	100	
24	Bullion, s. G.	Nev.	10,000,000	100,000	100	2,890,000 Aug. 1892 .25
25	Burlington, G. s.	Cal..	10,000,000	100,000		
26	Butte & Boston, C. s.	Mont.	5,000,000	200,000	10	
27	Butte Queen, G.	Cal..	1,000,000	100,000	1	6,000 Jan.. 1892 .04
28	Calaveras, G.	Cal..	500,000	500,000	5	
29	Calaveras Con., g.	Cal..	800,000	160,000	10	
30	California, G.	Cal..	1,000,000	100,000	5	9,000 Mar.. 1892 .03
31	California Con. L. Q..	Cal..	2,250,000	450,000	10	
32	Camille, g	Ga.	1,500,000	150,000	5	
33	Carisa, G.	Wy..	500,000	100,000	2	*
34	Carupano, G. s. L. C.	Ven..	200,000	100,000	2	*
35	Cashier, G. s.	Colo..	500,000	250,000	100	*
36	Challenge Con., g. s.	Nev..	5,000,000	50,000	10	
37	Cherokee, G.	Cal..	1,500,000	150,000	100	
38	Chollar, s. G.	Nev..	11,200,000	112,000	2	1,820,000 May.. 1892 .50
39	Cleveland, T.	Oak..	1,000,000	500,000	10	*
40	Colchis, s. G.	N. M..	500,000	150,000	5	
41	Colorado, s.	Colo..	1,625,000	325,000	1	
42	Comstock, s.	Utah.	1,250,000	250,000	100	
43	Comstock Tun.	Nev	10,000,000	100,000	100	35,000 Mar. 1887 .15
44	Con. Imperial, G. s	Nev..	5,000,000	50,000	50	2,062,500 Jan.. 1892 .25
45	Con. New York, s. G.	Nev..	5,000,000	100,000	100	110,000 Mar.. 1892 .10
46	Con. Pacific, G.	Cal..	6,000,000	60,000	10	195,000 June 1890 10
47	Con. Silver, s.	Mo..	2,500,000	250,000	5	
48	Cordova Union, g.	Cal..	1,000,000	200,000	10	
49	Crescent, s. L.	Colo..	3,000,000	300,000	100	*
50	Crocker, s.	Ariz..	10,000,000	100,000	1	165,000 Aug. 1892 .05
51	Crowell, G.	N. C..	500,000	500,000	1	
52	Dahlonega, G.	Ga..	250,000	250,000	10	*
53	Dandy, s.	Colo..	5,000,000	500,000		
54	Decatur s	Colo..	1,500,000	300,000		

DIVIDEND-PAYING MINES.

Name and Location of Company.		Capital Stock.	Shares. No.	Par	Assessments. Total Levied	Date and amount of last.			Dividends. Total paid.	Date & amount of last.	
Derbee B. Grav., G...	s.l	1[illegible],000 00	100,000	0	100,000	ept.	1892	.10	60,000	Aug..	1891 .10
Dexter, g. s.....	Nev..	1,000,000	100,000	10	*	....	....	....	80,000	Aug..	1892 .25
Dunkin, s. L...	Colo..	5,000,000	200,000	25	*	....	....	....	890,000	Oct..	1889 .05
Elkhorn, s. L...	Mont.	1,000,000	200 00	5	*	....	....	....	1,038,870	June	1893 .37½
Enterprise, s.	Colo..	2,500,000	500,000	5	*	....	....	....	850,000	May.	1893 .05
Eureka Con., s. L.. G.	Nev...	1,000,000	50,000	100	550,000	June	1889	.50	5,017,500	Jan..	1892 .25
Evening Star, s. L...	Colo..	500,000	50,000	10	*	....	....	....	1,450,000	Dec.	1889 .2
Father de Smet, G...	Dak..	10,000,000	100,000	100	200,000	Nov..	1878	1.00	1,125,000	Dec..	1885 .20
Franklin, c..	Mich..	1,000,000	40,000	25	220,000	June	1871	....	1,100,000	July	1892 2.00
Freeland, s. G.....	Colo..	5,000,000	200,000	25	*	....	....	....	90,000	April	1888 .12½
Garfield Lt., G. s....	Nev ..	500,000	100,000	5	....	....	....	....	10,000	June	1891 .10
Glengarry	Mont.	1,000,000	100,000	10	....	....	....	....	.....	Dec.	1891 .01
Gold Rock.....	Colo..	500,000	500,000	1	....	....	....	....	85,000	April	1893 .02
Golden Reward. . .	S.Dak	1,250,000	250,000	5	....	....	....	....	3,826,800	Oct.	1870 10.00
Gould & Curry, s. G..	Nev...	10,800,000	108,000	100	4,591,200	June	1892	.25	495,000	Mar.	1884 .25
Grand Prize, s.....	Nev...	10,000,000	100,000	100	785,000	Jan..	1890	.30	190,000	July.	1892 .10
Granite, s. L.....	Idaho	500,000	500,000	1	*	....	....	....	83,400	Nov.	1890 .02
Granite Mountain. s.	Mont.	10,000,000	400,000	25	....	....	....	....	12,120,000	July.	1892 .20
Great Western, L. Q..	Cal...	5,000,000	50,000	100	....	....	....	....	444,861	May.	1893 .25
Green Mountain, g..	Cal...	1,250,000	125,000	10	....	....	....	....	212,000	Nov.	1881 .07½
Hale & Norcross, G. s.	Nev...	11,200,000	112,000	100	5,534,800	Aug.	1892	.50	1,822,000	Aug.	1888 .50
Hecla Con., s. G. L. C.	Mont.	1,500,000	94,000	50	....	....	....	....	1,980,000	Apr.	1893 .50
Hel'a Mg.& Red,s.L.G.	Mont.	3,315,000	663,000	5	....	....	....	....	197,970	July.	1886 .06
Helena & Frisco, s.L.	Idaho	2,500,000	500,000	5	....	....	....	....	170,000	July.	891 .02
Helena & Victor.....	Mont.	1,000,000	200,000	5	....	....	....	....	80,000	May.	1892 .05
Holmes, s.....	Nev...	10,000,000	100,000	100	370,000	May.	1890	.25	75,000	Apr.	1886 .25
Homestake, G.....	Dak..	12,500,000	125,000	100	200,000	July.	1878	1.00	5,003,750	June	1893 .10
Homorine, s. L.....	Utah.	500,000	250,000	2	37,500	April	1889	.05	125,000	Sep.	1887 .05
Hope, s.....	Mont.	1,000,000	100,000	10	*	....	....	....	483,252	July.	1893 .25
Horn-Silver, s. L.....	Utah.	10,000,000	400,000	25	*	....	....	....	4,700,000	Mar.	1893 .12½
Hubert, G.....	Colo..	1,000,000	1,000,000	1	....	....	....	....	247,000	Dec.	1889 .00½
Idaho, G.....	Cal..	310,000	3,100	100	....	....	....	....	5,474,250	April	1893 2.50
Illinois, s.....	N. M..	100,000	100,000	1	*	....	....	....	45,000	April	1889 .20
Iron Hill, s.....	Dak..	2,500,000	250,000	10	134,000	July.	1889	.03	156,250	Nov..	1887 .07½
Iron Mountain, s....	Mont.	5,000,000	500,000	10	*	....	....	....	245,000	July.	1893 .03
Iron-Silver, s. L.....	Colo..	10,000,000	500,000	20	*	....	....	....	2,500,000	April	1889 .20
Jack Rabbit, G.....	Cal...	10,000,000	100,000	100	100,000	Sept.	1892	.10	260,000	Aug.	1891 .10
Jackson, G. s.....	Nev...	5,000,000	50,000	100	237,500	Nov..	1880	.20	60,000	Jan.	1891 .10
Kearsarge, C.....	Mich..	1,000,000	40,000	25	190,000	Oct..	1887	1.00	80,000	Jan.	1890 2.00
Kennedy.....	Cal...	10,000,000	100,000	100	....	....	....	....	387,000	May..	1892 .15
Kentuck, s. G.....	Nev..	3,000,000	30,000	100	454,180	Oct..	1891	.15	1,350,000	Dec.	1886 .10
La Plata, s. L.....	Colo..	2,000,000	200,000	10	*	....	....	....	610,000	Sept.	1892 .10
Leadville Con., s. L..	Colo.	4,000,000	400,000	10	*	....	....	....	316,500	Feb.	1892 .03
Lexington, G. s.	Mont.	4,000,000	40,000	100	*	....	....	....	609,000	Jan..	1890 2.00
Little Chief, s. L.....	Colo..	10,000,000	200,000	50	....	....	....	....	820,000	Dec..	1890 .05
Little Rule, s.....	Colo..	500,000	500,000	1	....	....	....	....	220,000	Dec..	1891 .02
Maid of Erin.....	Colo..	3,000,000	600,000	5	....	....	....	....	708,500	April	1893 .25
Mammoth, s. L. G.....	Utah	10,000,000	400,000	250	110,000	....	1882	.25	1,040,000	Dec..	1891 .10
Martin White, s.....	Nev.	10,000,000	100,000	100	1,275,000	Jan..	1892	.25	140,000	Dec..	1886 .25
Mary Murphy, s. G..	Colo.	350,000	3,500	101	*	....	....	....	175,000	May..	1888 5.00
Matchless, s. L.....	Colo.	500,000	500,000	1	*	....	....	....	15,000	Feb...	1890 .00½
Maxfield	Utah	3,000,000	300,000	10	....	....	....	....	117,000	April	1892 .03
Mayflower, D. grave)	Cal..	1,000,000	100,000	10	....	....	....	....	160,000	July	1893 .10
May Mazeppa, s. L...	Colo..	1,000,000	100,000	1	....	....	....	....	206,000	Oct..	1891 .03½
Minas Prietas, G. s..	Mex..	1,000,000	100,000	10	*	....	....	....	350,000	Dec..	1890 .50
Minnesota, C.....	Mich.	1,000,000	40,000	25	420,000	April	1886	1.00	1,820,000	Mar..	1876 .....
Mollie Gibson, s....	Colo.	5,000,000	1,000,000	5	....	....	....	....	3,680,000	July..	1893 .08
Monitor, G.....	S.Dak	2,500,000	250,000	10	....	....	....	....	45,000	Oct..	1890 .03
Mono, G.....	Cal..	5,000,000	500,000	100	760,000	Sept.	1890	.25	12,500	Mar.	1886 .25
Montana, L., G. s....	Mont.	3,300,000	660,000	5	*	....	....	....	2,619,075	June.	1891 12½
Morning Star, s. L....	Colo..	1,000,000	100,000	10	....	....	....	....	925,000	April	1891 .25
Morning Star Drift,G	Cal..	240,000	2,400	100	....	....	....	....	140,000	April	1893 3.00
Moulton, s. G.....	Mont.	2,000,000	400,000	5	*	....	....	....	410,000	Nov.	1892 .07½
Mt. Diablo, s.....	Nev..	5,000,000	50,000	100	137,500	June	1880	2.00	210,000	July.	1891 .20
Napa, Q.....	Cal..	700,000	100,000	7	....	....	....	....	580,000	July	1893 .20
Navajo, G. s.....	Nev..	10,000,000	100,000	100	520,000	May.	1891	.20	229,954	April	1885 .10
Newton.....	Cal...	10,000,000	100,000	100	....	....	....	....	10,000	May..	1891 .05
New California, G...	Colo..	800,000	160,000	5	*	....	....	....	48,800	May..	1890 .12½
New Guston, s.....	Colo..	550,000	110,000	5	....	....	....	....	1,377,500	April	1892 .75
North Banner Con..	Cal..	1,000,000	100,000	10	....	....	....	....	20,000	July..	1891 .05
North Commonw'th	Nev..	10,000,000	100,000	10	....	....	....	....	25,000	June.	1891 .25
N. Hoover Hill, G. s..	N. C	300,000	120,000	2½	*	....	....	....	30,000	Dec..	1888 .06¾
North Belle Isle, s...	Nev..	10,000,000	100,000	100	474,689	Nov.	1892	.10	230,000	May	1888 .50
North Star, G.....	Cal..	1,000,000	100,000	10	....	....	....	....	450,000	June	1893 .50
Omaha Cons., G.....	Cal...	2,400,000	24,000	100	....	....	....	....	30,000	May..	1892 .15
Ontario, s. L.....	Utah	15,000,000	150,000	100	....	....	....	....	13,175,000	Oct..	1892 .50
Ophir, G. s.....	Nev..	10,000,000	100,000	100	4,210,640	April	1890	.50	1,595,800	Jan..	1888 1.00
Original, s. C.....	Mont.	1,500,000	60,000	25	*	....	....	....	138,000	Jan..	1889 .05
Oro, s. L. G.....	Colo..	1,250,000	500,000	5	....	....	....	....	95,000	July.	1890 .20
Osceola, C..	Mich..	1,250,000	50,000	25	480,000	April	1876	1.60	1,747,500	May.	1893 1.00
Pacific Coast, B.....	Cal...	1,500,000	15,000	100	....	....	....	....	360,000	Dec.	1892 1.00
Parrot, C.....	Mont.	1,800,000	180,000	10	....	....	....	....	1,748,000	April	1893 .10
Petro.....	Utah.	10,000,000	10,000	100	....	....	....	....	17,500	July	1891 .15
Plumas Eureka, G..	Cal...	1,406,250	140,625	10	....	....	....	....	2,669,926	April	1893 .19
Plymouth Con , G....	Cal..	5,000,000	100,000	50	*	....	....	....	2,280,000	Feb.	1892 .40
Poorman; G. s.....	Idaho	375,000	300,000	125	*	....	....	....	68,280	Septl	1891 .....
Quicksilver, pref., Q	Cal...	4,300,000	43,000	100	....	....	....	....	1,423,911	June	1891 1.25
" com., Q	Cal...	5,700,000	57,000	100	....	....	....	....	643,867	July.	1882 .40
Quincy, C.....	Mich..	1,250,000	50,000	25	200,000	Dec..	1862	....	6,620,000	Aug..	1893 3.00
Red Cloud.....	Idaho	1,000,000	200,000	5	*	....	....	....	153,000	Dec.	1892 .10
Reed National, s. G..	Colo..	500,000	500,000	1	*	....	....	....	50,000	Dec..	1890 .01
Retriever, L.....	S.Dak	1,250,000	250,000	5	....	....	....	....	20,000	Aug..	1891 .03
Rialto, G.....	Colo..	300,000	300,000	1	*	....	....	....	50,250	April	1892 .01½
Richmond, s. L.....	Nev..	1,350,000	54,000	25	*	....	....	....	4,346,325	Aug..	1891 .25
Rico-Aspen.....	Colo..	5,000,000	1,000,000	5	....	....	....	....	25,000	May.	1893 .02½
Ridge, C.....	Mich..	500,000	20,000	25	219,933	Mar.	1886	50	99,785	Feb..	1888 .50
Robinson Con., s. L..	Colo..	10,000,000	200,000	50	*	....	....	....	585,000	Mar.	1892 .05
Running Lode, G....	Colo..	1,000,000	1,000,000	1	*	....	....	....	36,000	May.	1892 .00 1-2
Savage, s.....	Nev..	11,200,000	112,000	100	6,772,000	Feb..	1892	.50	4,460,000	June	1869 3.00
Sberidan, s. G.....	Colo..	300,000	3,000	100	*	....	....	....	300,000	Oct..	1891 2.50
Shoshone, G.....	Idaho	150,000	150,000	1	....	....	....	....	7,500	April	1888 .01
Sierra Buttes, G.....	Cal...	2,225,000	122,500	10	....	....	....	....	1,344,620	April	1893 .12½
Sierra Nevada, s. G..	Nev...	10,000,000	100,000	100	6,411,910	June	1892	.25	102,000	Jan..	1871 1.00
Sierra Nevada, s. L..	Idaho	1,000,000	1,000,000	1	*	....	....	....	40,000	May..	1889 .02
Silent Friend.....	Colo..	500,000	500,000	1	....	....	....	....	60,000	Aug..	1891 .02½
Silver Cord, s. L. G...	Colo..	4,500,000	450,000	10	....	....	....	....	265,000	April	1885 .10
Silver King, s.....	Ariz..	10,000,000	100,000	100	130,000	Nov.	1890	.30	1,950,000	July	1887 .25
Silver Mg.of L.V.,s.L.	N. M..	500,000	500,000	1	....	....	....	....	300,000	Dec..	1891 4.05
Silde.....	Colo..	500,000	5,000	100	....	....	....	....	30,000	Nov..	1891 4.00
Small Hopes Con., s.	Colo..	5,000,000	250,000	20	*	....	....	....	32,000,000	Nov..	1892 .15
Spring Valley, G.....	Cal...	200,000	200,000	1	50,000	Oct.	1886	.25	50,000	Jan..	1881 .25
Standard, G. s.....	Cal...	10,000,000	100,000	100	100,000	June	'89	.50	3,665,000	July.	1893 .10
Stormont, s.....	Utah.	500,000	500,000	1	*	....	....	....	155,000	Nov.	1881 .05
St. Joseph, L.....	Mo..	1,500,000	150,000	10	*	....	....	....	1,974,000	Dec..	1890 .02
Swansea, g. s.....	Colo..	600,000	60,000	10	....	....	....	....	27,000	Mar.	1893 .10
Tamarack, C.....	Mich..	1,250,000	50,000	25	520,000	April	1885	3.00	3,160,000	Oct..	1892 .00
Teal & Poe.....	N. M..	150,000	150,000	1	....	....	....	....	9,000	Nov.	1891 .01½
Tombstone, G. s. L..	Ariz..	12,500,000	500,000	25	*	....	....	....	1,250,000	April	1882 .10
Trinity Riv'r Hydr.,G	Colo..	500,000	50,000	1	*	....	....	....	10,000	May.	1893 .00½
United Verde, C.....	Ariz..	3,000,000	300,000	10	*	....	....	....	207,500	Jan..	1892 .10
Victor, G....	Colo..	1,000,000	200,000	5	....	....	....	....	40,000	June	1893 .05
Viola L., s. L.....	Idaho	750,000	150,000	5	....	....	....	....	337,500	Nov.	1888 .37½
Ward Con., s.....	Colo.	2,000,000	200,000	10	....	....	....	....	20,000	Dec.	1889 .05
Woodside, s. L.....	Utah	100,000	100,000	10	....	....	....	....	25,000	Oct..	1889 .25
W. Y. O. D.	Cal..	30,000	15,000	2	22,500	May.	1891	.10	58,500	July.	1893 .10
Yankee Girl, s.....	Colo.	1,300,000	260,000	5	....	....	....	....	1,405,000	April	1891 1.50
Yellow Jacket, G. s..	Nev.	12,000,000	120,000	10	5,808,000	Sept.	1892	.25	2,184,000	Aug.	1871 1.50
Yosemite No. 2.....	Utah.	1,000,000	100,000	10	....	....	....	....	25,000	Oct..	1891 .05
Young America, G...	Cal...	.....	.....	....	.....	....	....	....	175,000	Jan..	1891 1.00

NON DIVIDEND-PAYING MINES.

Name and Location of Company.		Capital Stock.	Shares. No.	Par	Assessments. Total levied.	Date and am't of last.		
Denver City s.....	Colo..	5,000,000	500,000	11	*	.....	....	.....
Denver Gold, G.....	Colo..	300,000	60,000	5	.....	.....	....	.....
Dickens-Custer, s....	Idaho	2,100,000	420,000	5	.....	.....	....	.....
Durango, G.....	Colo..	500,000	500,000	1	*	.....	....	.....
Eastern Dev. Co., Lt	N. S..	1,500,000	150,000	10	990,000	Mar.	1886	1.00
El Dorado, G.....	Cal...	1,000,000	250,000	4	*	.....	....	.....
El Talento, G.....	U.S.C.	1,000,000	500,000	2	.....	.....	....	.....
Emma, s	Utah.	625,000	2,000,000	125	.....	.....	....	.....
Emmons, s. L.....	Colo..	2,000,000	100,000	1	.....	.....	....	.....
Empire, s.....	Utah	10,000,000	100,000	100	*	.....	....	.....
Eureka Tunnel, s. L.	Nev..	10,000,000	100,000	100	*	.....	....	.....
Exchequer, s. G.	Nev...	10,000,000	100,000	100	940,000	Jan..	1892	.25
Found Treasure, G. s.	Nev...	10,000,000	100,000	100	130,500	Jan..	1892	.50
Gogebic I. Syn., I....	Wis..	5,600,000	200,000	25	.....	.....	....	.....
Gold Bank, g. s.....	Colo.	250,000	250,000	1	*	.....	....	.....
Gold Cup, s.....	Colo..	500,000	500,000	1	*	.....	....	.....
Golden Era, s.....	Mont.	2,000,000	200,000	10	*	.....	....	.....
Gold Flat, G..	Cal...	1,000,000	100,000	10	5,000	Mar.,	1892	.05
Gold King, G.....	Colo..	1,650,000	350,000	5	.....	.....	....	.....
Gold Rock, G.....	Cal...	1,000,000	500,000	2	.....	.....	....	.....
Golden FeatherCu..g	Cal...	900,000	180,000	5	.....	.....	....	.....
Goodshaw, G.....	Cal...	10,000,000	100,000	100	*	.....	....	.....
Goodyear G. s. L	Mont.	1,000,000	200,000	5	13,000	Feb..	1892	.01
Grand Belt, C	Tex..	12,000,000	120,000	100	.....	.....	....	.....
Grand Canyon, s.....	Ariz..	375,000	75,000	5	.....	.....	....	.....
Grand Duke, s.....	Colo.	800,000	80,000	10	.....	.....	....	.....
Gregory Con., G.....	Mont.	3,000,000	300,000	10	.....	.....	....	.....
Harlem M. & M. Co.,G.	Cal...	1,000,000	200,000	5	.....	.....	....	.....
Hartery Con., G.....	Cal...	1,000,000	100,000	10	22,000	Oct..	1890	.05
Hartshorn, g s. l. .	S.Dak	1,250,000	250,000	5	8,250	Sept.	1891	.00½
Head Cent. & Tr., s. G	Ariz..	10,000,000	100,000	100	16,981	Mar..	1892	.03
Hector, G.....	Cal...	1,500,000	300,000	5	45,000	Jan..	1889	.15
Highland, C.....	Mich..	500,000	25,000	20	.....	.....	....	.....
Himalaya, g. s l....	Utah.	1,800,000	80,000	10	12,800	Oct..	1892	.00½
Holywood.....	Cal...	200,000	100,000	2	.....	.....	....	.....
Hortense, s.....	Colo..	2,000,000	200,000	10	.....	.....	....	.....
Huron, C.....	Mich..	400,000	40,000	25	280,000	May.	1887	3.00
Idaho, g. s	Idaho	1,250,000	250,000	5	.....	.....	....	.....
Inez, s. L	Idaho	1,000,000	1,000,000	1	.....	.....	....	.....
Ingalls, g	Colo..	100,000	20,000	5	.....	.....	....	.....
Ironton, I.....	Wis..	1,000,000	40,000	25	.....	.....	....	.....
Iroquois, C.....	Mich..	1,250,000	50,000	25	.....	.....	....	.....
Kentuck Con.....	Nev..	10,500,000	105,000	100	57,750	July.	1892	.10
J. D. Reymert, s.....	Ariz..	16,000,000	100,000	100	.....	.....	....	.....
Julia Con., G. s.... .	Nev...	11,000,000	110,000	100	1,463,000	Jan..	1889	.10
Justice, g. s. c.....	Colo.	500,000	500,000	1	*	.....	....	.....
Lacrosse, G.....	Colo..	1,000,000	100,000	10	*	.....	....	.....
La Cumbre, g. s....	Mex..	150,000	3,000	50	*	.....	....	.....
Lee Basin, s.....	Colo..	5,000,000	500,000	10	*	.....	....	.....
Little Josephine, s..	Colo..	250,000	50,000	5	.....	.....	....	.....
Lone Star Cons., G..	Cal...	500,000	500,000	1	10,000	April	1892	.00½
Lynx Creek, g.....	Ariz..	237,500	147,500	5	.....	.....	....	.....
Madeleine, G. s. L....	Colo..	750,000	50,000	1	4,500	Feb.	1892	.00½
Mammoth Gold, G..	Ariz..	2,500,000	500,000	5	*	.....	....	.....
Mayflower Gravel,G.	Cal...	1,000,000	100,000	10	*	.....	....	.....
Medora, G..... ...	Dak..	250,000	250,000	1	585,000	Mar.	1890	.56
Merrimac Con., G. s.	Colo..	5,000,000	500,000	10	.....	.....	....	.....
Mexican, G. s.....	Nev...	10,000,000	100,000	100	2,917,560	ct..	1892	.50
Michigan, g s	Mich..	2,500,000	100,000	25	40,000	Mar..	1892	.....
Middle Bar, G..	Cal...	400,000	200,000	2	*	.....	....	.....
Mike & Starr, s. C...	Colo..	1,000,000	200,000	5	*	.....	....	.....
Milwaukee, s..... ..	Mont.	500,000	500,000	1	.....	.....	....	.....
Minah Cons	Mont.	1,250,000	250,000	5	.....	.....	....	.....
Modoc Chief, I. s. g.	Idaho	1,000,000	200,000	5	5,000	Jan..	1892	.00½
Monitor, G.....	Colo..	100,000	100,000	1	12,500	May.	1891	.01
Montreal, G. s. L....	Utah.	750,000	150,000	5	4,500	Feb..	1892	.00½
Mountain Ledge, g .	Cal...	500,000	100,000	5	.....	.....	....	.....
Mount McClellan...	Colo.	1,500,000	300,000	5	*	.....	....	.....
Mutual Mg. & Sm...	W'sh.	100,000	100,000	1	*	.....	....	.....
Native, C.....	Mich..	1,000,000	40,000	25	.....	.....	....	.....
Neath. G.....	Colo..	1,000,000	100,000	10	.....	.....	....	.....
Nelson.....	Cal...	50,000	10,000	5	.....	.....	....	.....
Nevada Queen, s....	Nev..	10,000,000	100,000	100	200,000	Oct..	1888	.25
New Germany, G....	S. N.	100,000	100,000	1	*	.....	....	.....
New Gold Hill.....	N. C.	1,750,000	350,000	5	.....	.....	....	.....
New Pittsburg, s. L..	Colo..	2,000,000	200,000	10	*	.....	....	.....
New Queen Gold, s..	Colo..	800,000	160,000	5	.....	.....	....	.....
North Standard, G..	Cal...	10,000,000	100,000	100	20,000	Nov.		
Occidental Con., g.s	.....	10,000,000	100,000	100	245,000	April	1892	.25
Oneida Chief, G.....	Cal...	500,000	125,000	100	*	.....	....	.....
Oriental & Miller, s.	Nev...	10,000,000	400,000	100	.....	.....	....	.....
Original Keystone, s	Nev..	10,000,000	100,000	100	250,000	Mar..	1892	.10
Osceola, G.....	Nev...	5,000,000	500,000	10	.....	.....	....	.....
Overman, G. s.....	Nev...	11,520,000	115,200	100	4,001,846	May.	1892	.10
Park, s.....	Utah	2,000,000	200,000	10	.....	.....	....	.....
Parker. g.....	N. C..	750,000	180,000	.....	.....	.....	....	.....
Pay Rock, s.....	Colo..	1,000,000	200,000	5	.....	.....	....	.....
Peer, s.....	Ariz..	10,000,000	100,000	100	190,000	Feb..	1892	.10
Peerless, s.....	Ariz..	10,000,000	100,000	100	405,000	Oct..	1890	.15
Pennsylva'a Cons., G	Cal...	5,150,000	515,000	10	36,050	Feb..	1892	.10
Phœnix, g.....	Ariz..	500,000	500,000	1	*	.....	....	.....
Phœnix Lead, s. L...	Colo..	100,000	100,000	1	*	.....	....	.....
Pilgrim, G	Cal...	600,000	300,000	2	*	.....	....	.....
**Pioche M.&R.,s.G.L.	Utah.	20,000,000	2,000,000	10	.....	.....	....	.....
Poorman, Ltd., s. L.	Idaho	250,000	50,000	5	.....	.....	....	.....
Potosi, s.....	Nev...	11,200,000	112,000	100	1,573,000	Mar..	1890	.50
Proustite, s.....	Idaho	250,000	250,000	1	*	.....	....	.....
Puritan, s. G.....	Colo..	1,500,000	150,000	10	*	.....	....	.....
Quincy, c. G.....	Colo..	3,000,000	300,000	10	.....	.....	....	.....
Rainbow, g.....	S.Dak	1,250,000	250,000	5	4,250	July.	1892	.00½
Rappahannock, G. s	Va....	250,000	250,000	1	*	.....	....	.....
Red Elephant, s.....	Colo..	500,000	500,000	1	*	.....	....	.....
Red Mountain, s....	Colo..	300,000	60,000	5	.....	.....	....	.....
Ropes, G. s.....	Micn..	2,000,000	80,000	25	167,200	Feb.	1891	.50
Ruby & Dun., s. L. G.	Nev...	25,300	506	50	*	.....	....	.....
Russell, G.....	N. C..	1,500,000	300,000	5	.....	.....	....	.....
Sampson, G. s. L....	Utah.	10,000,000	100,000	100	288,154	July.	1888	1.08
Seal of Nevada, g.s..	Nev..	5,000,000	100,000	50	.....	.....	....	.....
Silver Age, s. l. g....	Colo..	2,000,000	200,000	10	*	.....	....	.....
Silver Bell, s.....	Ariz..	850,000	170,000	5	.....	.....	....	.....
Silver King, s.....	Cal. .	2,000,000	400,000	5	.....	.....	....	.....
Silver Queen, C.... ..	Ariz..	5,000,000	200,000	25	*	.....	....	.....
Silverton, s.....	Colo..	300,000	60,000	5	.....	.....	....	.....
Siskiyou Con., L.....	Cal...	2,000,000	200,000	10	13,000	May..	1892	.01½
South Bulwer, G	Cal..	10,000,000	100,000	100	100,000	May.	1881	.25
South Hite, g.....	Cal..	10,000,000	100,000	100	195,000	Jan..	1888	.05
South Pacific, g.....	Cal..	500,000	500,000	5	.....	.....	....	.....
Stanislaus, G.....	Cal..	2,000,000	200,000	10	.....	.....	....	.....
St. Kevin, s. G.....	Colo.	100,000	100,000	1	*	.....	....	.....
St. Louis & Mex., s...	Mex..	1,000,000	500,000	10	*	.....	....	.....
St. Louis & St. Elmo.	Colo..	1,000,000	200,000	10	.....	.....	....	.....
St. L. & St. Felipe, G.s.	Mex..	500,000	150,000	10	.....	.....	....	.....
St. L. & Sonora, G. s..	Ariz..	3,000,000	300,000	10	*	.....	....	.....
Sten winder, I. s....	Idaho	500,000	500,000	1	.....	.....	....	.....
Sunday Lake, I.....	Mich..	1,250,000	50,000	25	.....	.....	....	.....
Sullivan Con., G.....	Dak..	600,000	200,000	3	*	.....	....	.....
Sylvanite, s.....	Colo..	5,000,000	500,000	10	*	.....	....	.....
Taylor-Plumas, G....	Cal...	325,000	65,000	5	3,575	Mar..	1892	.01½
Telegraph, g. s.....	Cal...	325,000	65,000	5	3,575	Mar.	1892	.01½
Telegraph, G. s.....	Mex..	100,000	100,000	1	70,000	Feb..	1892	.10
Teresa, G. s.....	C

COAL AND COAL RAILROAD STOCKS.

NAMES OF STOCKS.	July 22.		July 24.		July 25.		July 26.		July 27.		July 28.		Sales.
	H.	L.	H.	L.	H.	L.	H.	L.	H.	L.	H.	L.	
Am. Coal													
Balt. & Ohio	66				65		61½	57½	55	54½	57½	56	2,207
do. pref													
Buff., R. & P.			29				28	25			23		1,150
do. pref			78				77	75					300
Cambria Iron													
Ches. & Ohio	15	14¼	14½	14⅜	14½	14¼	14⅛	13⅛	14¼	13	14½	14	13,548
do. 1st pref													
Col. C. & I.													
Col. Coal													
Colorado Fuel	21				21	20			20				1,122
do. pref													
Col., H.V.& Tol.	17½		17½	16½	17	16½	16	14¾	15½	14½	17½	16¼	5,480
do. pfd													
Col. & H. Coal	6¼	6							6		5¾	5½	900
do. pfd													
Cons. Coal													
Del. & Hud. C.	114⅞	114⅝	115½	114½	114⅝	114	111	102¾	105⅝	103½	109½	107	7,599
Del., L. & West.	138¾	137¾	140	138	138¾	136	136¾	130	133½	127	133¾	130⅝	72,474
Hunt. & B.Top.													
do. pref	50												455
Lake Erie&Wes	15		14½		14½	14	13½	13	13¾	12½	13		3,030
do. pref	68½		67	65½	65¼	65	58		58	56	59½	54½	5,436
Lehigh C. & N.			49½	49	48¾		48¾	48¼	47¼	47			313
Lehigh Valley	35	32½	34	33⅝	34	33⅝	33¾	30½	33⅝	31⅜			11,069
Maryland Coal													
do. pref					57½								10
Morris & Essex					140		140		140				253
New Cent. Coal					7								100
N. J. Central	97¼		96	94	95	93	91	84	87	84⅛	90	87½	8,678
N. Y., L. & W.													
N. Y., L. E.& W	12¼	10¾	11⅞	11	11⅜	10½	9⅝	2¾	9⅞		10¼	9½	75,698
do. pref	25		25	21¾	23½	20	19	15	20	18	23	21	6,895
N.Y., Susq. & W	11		10⅝	10½	10¾	10	10	9	8¼	8	10½	10	4,580
do. pref			39¾	39¼	39¾	39							200
do. pref., new									38¾		41	39½	820
N. & West													
do. pref			19½		19		17⅝	16¾	19⅜	17⅛			2,807
Penn. Coal													
Penn. R. R	48⅝	48¾	48⅝	48⅜	48⅜	48⅛	48¼	46½	49	47¼			18,709
Phil. & Reading	13¾	13	13⅜	13¼	13½	13¾	13⅜	12½	13	12¼	13½	12¾	23,682
Tenn. C. & I.	13½		13¼	12½	13¼	12⅜	12	10½	13	11¼	12¼	12	9,623
do. pref													
Wheel. & L. E.	12	11½	11¼		1		10¼	10	12½	10⅜	11⅝	11¼	2,135
do. pref	44½	41	43		45		41	34	35	31	38½	34	5,000

Total shares sold, 284,271.

INDUSTRIAL AND TRUST STOCKS.

NAME OF STOCKS.	July 22.		July 24.		July 25.		July 26.		July 27.		July 28.		SALES.
	H.	L.	H.	L.	H.	L.	H.	L.	H.	L.	H.	L.	
Adams Express	148				146	145			135				180
Am. Cotton Oil.	28	26½	27½	26¾	28	27½			27⅜	27	27	24½	7,223
do. pref	57				58	56	51	50	56	54	58¼	55	2,085
Am. Dist. Tel.													
Am Express	110		110	108¼			110	106	108½	108			241
Am. Sugar Ref.	73½	7 ¾	74	71	73	70⅝	71½	67	71½	66¾	72¼	67¾	138,588
do. pref	74½	74¼	74⅛	72½	73¾	73⅜	71⅝	68½	71	68¾	73¼	71½	4,898
Edison E. Ill. Co.	97¼		96½				91	90					20
Edison Gen. El.	49¼	47¾	51⅜	48¾	50⅜	45	47½	40½	43¾	41	45¾	31¼	149,080
Nat. Cord. Co.	10		9⅞		9½	9							750
do*	14½		15		14		13⅜		13	10	12½	12	1,505
do. pref					32								110
do.*									42				400
Nat. Lead Co.	25	23	23¼	21¼	22½	21	21½	20⅛	21½	18½	22½	19½	22,892
do. pref	58½	57½	55½	54	56	54	53	48	53	48	54½	51	6,886
Nat. Linseed Oil.							15		15	14½	15	14½	1,575
U. S. Express						50			53	50	50		205
U. S. Rubber	31		30				25		28½	26¾	30		800
do. pref	69		71	69¾	70	66	68		65				300
Wells, Fargo Ex			140	135	140		141						47
Western Union	76	74¾	75½	73⅝	74⅜	72¼	73¼	67⅛	72⅜	67⅜	72½	69½	179,654

*First assess. paid. Total sales, 517,309.

CALIFORNIA.

San Francisco.

NAMES OF STOCKS.	CLOSING QUOTATIONS. July 21.	July 22.	July 24.	July 25.	July 26.	July 27.
Alpha						
Alta	.10	.10	.10	.10	.10	.10
Belcher	.30	.30	.35	.35	.30	.35
Belle Isle						
B. & Belch	.60	.60	.60	.55	.55	.55
Bodie	.10	.10	.05	.05	.05	
Bulwer						
Challar	.35	.30	.25	.25	.25	.25
Com'w'lth						
Con.C.&V.	1.30	1.20	1.15	1.15	1.10	1.10
Con. Pac.						
Crown Pt.	.35	.35	.40	.36	.30	.30
Del Monte						
E'rekaCon						
G'ld & C'y	.55	.40	.35	.40	.35	.30
Hale & N.						
M. White						
Mexican	.40	.40	.40	.35	.35	.35
Mono						
Mt. Diablo						
Navajo						
Nev. Qu'n.						
N.B'lleIsle			.70			
N. Co'w'th						
Ophir	.70	.70	.70	.65	.60	.60
Potosi		.45	.45	.40	.40	.35
Savage	.40	.45	.40	.35	.35	.30
Sierra Nev	.45	.40	.45	.45	.35	.35
Uni'n Con	.35	.35	.35	.35	.35	.35
Utah	.10	.10	.10	.10		.10
Yel. Jack	.50	.50	.50	.40	.40	.40

COLORADO.

Aspen. July 1.

	Bid.	Asked
Argentum Juniata	$0.69	$0.70
Aspen Contact	1.10	1.12
Aspen Deep Mining	.11	.11½
Best Friend	.07½	.08
Bi-Metallic	.07½	.08
Bushwacker	.14	.15
Delia S.	1.90	2.00
Gold Valley Placer	.20	.20
Little Annie	.07½	.08
Mollie Gibson	5.50	6.00
Pontiac	.09	.09½
Smuggler	35.00	38.00
St. Joe & Mineral Farm	.10½	.11
U. S. Paymaster		

Colorado Springs. July 24.

	Bid.	Asked.
Anaconda Gold		.15½
Antlers P. K. Reg		.10
Calumet	0.2¼	.03
Cleopatra		.09½
C. O. D.	.01¾	.02½
Cook's Peak		.40
Del Monte		.04½
Enterprise	.02½	.05
Fanny Rawlins	.07	
Golden Dale	.00¾	.02
Isabella		.14
Lemhi	.80	.95
Mollie Gibson	1.65	1.75
Mount Rosa		.01
Pharmacist	.20½	.21½
Summit M. & M.		.14
Work	.2½	.03
World		.01⅜

Denver.

Prices and sales for the week ending July 4:

	High.	Low.	Sales.
Anaconda	$.26	$.21	500
Bangkok-Cora Belle	.02¾	.02	
Diamond B	.03	.02	6,500
Gold Rock	.04½	.03	400
Justice	.01½	.01¼	300
Puzzler	.04	.03	
Work	.03	.02¾	42,3.0
Total sales			50,000

MONTANA.

Helena.

Prices for the week ending July 15:

	Bid.	Asked.
Bald Butte (Mont.)	$2.25	$2.50
Benton Group (Neihart), Mont.	.12½	.20
Combination(Phillipsb'g),Mont	.85	1.00
Cumberland (Castle), Mont		
Elizabeth (Phillipsb'g), Mont		.35
Florence (Neihart)		
Helena & Victor, Mont		.75
Iron Mountain(Missoula), Mont	.52½	.60
Piegan (Marysville), Mont	.25	.50
Peorman (Cœur d'Alene), Idaho	.50	.60
Whitlach Union & MacIntyre	.30	.40
Yellowstone		

MARYLAND.

Baltimore. July 27.

COMPANY.	Bid.	Asked.
Balt. & N. C.		$0.04
Conrad Hill		
Cons. Coal		.32
Diamond Tunnel		.15
George's Creek Coal.	$1.00	1.07@1.11
Howard C. & C.	1.10	
Lake Chrome	.01@.02	
Silver Valley	.03	

MINNESOTA.

Duluth. July 21.

LISTED STOCKS.

	Par.	Bid.	Asked
Biwabik M. Iron Co	100	$18.50	$22.00
Cincinnati Iron Co	25	.35	.40
Clark Iron Co	100	.40	.60
Cosmopolitan Iron Co			
Great Northern Min. Co.	100	2.25	2.75
Kanawha Iron Co	100	.15	.30
Keystone Iron Co			.50
Lake Superior Iron Co	25	1.00	2.00
Lincoln Iron Co			.50
Little Mesaba Iron Co	100		
Mesaba Moun. Iron Co.	100	11.00	13.00
Minneapolis Iron Co	100	.05	.20
Mountain Iron Co	100	45.00	60.00
Shaw Iron Co	100	.75	1.10
Security Land & Exp. Co.	10	14.00	17.00
Washington Iron Co	100		

UNLISTED STOCKS.

Adams Iron Co	$8.00	$9.00
Agate Copper Mining Co		.30
Allegheny Iron Co	64	
Aurora Iron Co		
Buckeye Iron Co		2.50
Buffalo Land & Exp. Co.		.50
Camden Iron Co		.25
Chandler Iron Co		50.00
Chicago Iron Co	.10	.50
Charleston Iron Co	.11	.35
Champion Iron Co	.11	.40
Cleveland Iron Co		
Columbia Iron Co		
Commodore Mining Co		
Comstock Iron Co		
Dayton Iron Co		
Detroit Iron Co	.01	.03
Elmira Land & Iron Co	.10	.25
Great Western Mining Co.	1.00	1.50
Hall Iron Co		
Homestead Iron Co	.00½	.03
Horton Mining Co		
Imp. Iron Mt. Mining Co.		
Internat'l Development		22.50
Kakina Iron Co		
Kentucky Iron Co		
Lackawanna Iron Co	.45	.60
Macomber Mining Co		
McCaskill Mining Co	.01	.05
McKinley Iron Co		24.50
Mesaba C., L. & Ex. Co.		6.00
Mesaba Chief Iron Co	1.80	2.25
Mesaba Iron Co		.20
Mesaba Mineral Co		
Minnesota Iron Co	45.00	60.00
Myrna Iron Co		
Northern Light Iron Co		.25
New England Iron Co		
Ohio Mining Co		6.00
Oneota Iron Co		
Ophir, gold	1.00	1.50
Pennsylvania I. & S. Co.	.04	.10
Pioneer		1.00
Putnam		.80
Rouchleau Iron Co	.30	.50
Republic Iron Co		.50
Red Hematite Iron Co		.15
Sheridan Iron Co		.20
Standard Ore Co	.25	.50
Stowell Iron Co		
Towanda Iron Co	1.50	2.00
Ver. & Mesaba Iron Co.		1.00
Zenith Iron Co		1.25

MISSOURI.

St. Louis. July 26.

Closing quotations:

	Bid.	Asked.
Adams	$0.40	$0.75
American & Nettie, Colo.	.30	.35
Bi-Metallic, Mont		4.00
Elizabeth, Mont	.15	.25
Granite Mountain, Mont.	1.25	
Hope		2.50
Leo	.01½	.03
Pat Murphy		
Small Hopes		.50

PENNSYLVANIA.

Philadelphia. July 27.

(Special report by SAM'L K. DAVIS.)

	Bid.	Asked.
Bloomington C. & C.		
Buck Mountain C.		
Cambria	64	
Connellsville Gas Co.		
Edison E. Light Co.	115	121
Excelsior B. & S.		
Locust Mt. C. & I.		
Penn. Salt		102½@103
Penn. Steel		54
Penn. Gas Coal	.47	
Royal Gas		
Westmoreland C.	.50	

Pittsburg. July 26.

	Bid.	Asked.
Bridgewater Gas Co.	$35.00	
Chartiers Val. Gas.		$10.00
Con. Gas	45.00	
Enterprise Mining Co.		1.50
Hidalgo Mining Co.	1.75	
La Noria Mining Co.	7.75	8.38
Luster Mining Co.	8.00	8.50
Manufacturers' Gas.	29.00	30.00
N. Y. & Clev. G. C.		51.00
Ohio Valley Gas		32.00
Pennsylvania Gas		9.00
People's N. G. & P. Co.	13.88	
Philadelphia Co.	18.88	19.13
South Side Gas		
Tuna Oil		
Wheeling Gas Co.	15.00	19.00
W'house Air Brake Co.		118½

London Quotations.

	July 19, 1893. Buyer. £ s. d.	Seller. £ s. d.
Alaska Treadwell,		
Alaska Ter.	1 15 0	2 0 0
Almada & Tirito, Mex.	3	9
American Belle, Colo.	1 0	1 6
Big Creek, Nev.	5 0	10 0
De Lamar, Idaho	15 0	17 6
Elkhorn, Mont.	10 6	11 6
Emma, Utah	9	1 3
Flagstaff, Utah	7½	10½
Golden Feather, Cal.	11 6	12 6
Golden Gate, Cal.	3 0	4 0
Golden Leaf, Mont. & N. M.	3	9
Holcomb Valley, Cal.	9	11
Jackson Gold Fields.	10½	1 1½
Jay Hawk & Lone Pine, Mont.	6 0	7 0
Maid of Erin, Colo.	2 6	7 6
Mammoth Gold, Ariz.	9	1 0
Mesquital del Oro, Mex., P.	3 0 0	4 0 0
Mesquital del Oro, Mex., D.	15 0	1 5 0
New Eberhardt, Nev.		3
New Guston, Colo.	6 3	8 9
New Montana, Mont.	2 6	3 0
Palmarejo, Mex.	6	1 0
Pinos Altos, Mex.	1 0	1 6
Poorman, Idaho	6 0	7 0
Rajah Gold, Can.	6 3	8 9
Richmond Con., Nev.	6 3	8 9
Seven Stars, Ariz.	1 5 0	1 10 0
Sierra Buttes, Cal.	6 0	8 0
" " Plumas Eur., Cal.	7 0	9 0
South Poorman, Idaho	1 2 6	1 5 0
Springdale Gold, Colo.	3 0	4 0
United Mexican, Mex.	2 0	3 0
Yankee Girl, Colo.	6	1 0

Paris. July 13.

	Francs.
Belmez, Spain	665.00
Golden River, Cal.	130.00
" " parts	30.00
Laurium, Greece	630.00
Lexington, Mont.	82.50
" parts	2.00
Nickel, New Caledonia	735.00
Rio Tinto, Spain	372.50
" " oblig.	530.00
" " 2d	535.00
Tharsis, Spain	118.75
Vieille-Montagne, Belgium	485.00

New York Mining Stocks.

(Latest quotations.) July 28.

	Bid.	Asked.
Adams		
Alice		
Alta		
Amer. Flag		
Aspen		
Belcher		
Best & Belcher.		
Bodie		
Breece		
Brunswick		
Bulwer		
Caledonia, B. H.		
Carth Creek		
Challar		
Chrysolite		
Comstock Tunnel		
Colo. Central		
Con. C. & Va		$1.20
Crown Point		
Deadwood		
El Cristo		
Enterprise		
Gould & Curry		
Hale & Nor.		
Horn Silver		
Iron Silver		
Kingston & Pem.		
La Crosse		
Leadville		
Little Chief		
Mexican		
Mono		
Ophir		
Phœnix of Ariz.		
Plymouth		
Savage		
Sierre Nevada		
Union		
Yellow Jacket		

ASSESSMENTS.

COMPANY.	No.	Dlnqt. in office.	Day of sale.	Amt. per sh're
Alta, Nev.	43	Aug. 4	Aug. 25	.15
Best & Belcher	54	July 14	Aug. 4	.25
Calumet, S.Dak	1	July 24	Aug. 14	.32
Crocker, Nev	14	July 9	Aug. 3	.05
Crown Pt., Nev	61	July 18	Aug. 8	.25
Darboy, S. Dak	3	July 25	Aug. 14	.002
Excheq er, Nev	36	Aug. 1	Aug. 29	.10
Gold Mt., Cal.	5	Aug. 16	Sept. 4	1.50
H'le&Nor.,Nev	104	July 25	Aug. 18	.50
Justice, Nev.	54	July 11	Aug. 2	.10
Lady Washington, Nev.	9	Aug. 9	Aug.30	.10
Occid'ntal, Nev	13	July 26	Aug. 17	.10
Peer, Nev.	15	July 9	Aug. 2	.05
Potosi, Nev.	38	Aug. 15	Sept. 5	.25
RedJacket,Nev	1	July 15	Aug. 5	.05
Savage, Nev.	81	July 25	Aug. 14	.05
Utah, Nev.	18	July 8	Aug. 5	.10
Weldon, Ariz.	7	July 16	Aug. 9	.05
Yosemite No. 2, Utah		Aug. 18	Sept. 5	.05

CLASSIFIED LIST OF ADVERTISERS.

Adders and Calculators
Smith, R. C.
Air Compressors and Rock Drills
American Diamond Rock Boring Co.
Bullock, M. C., Mfg. Co.
Burleigh Rock Drill Co.
Clayton Air Compressor Works.
Hasenzahl, W.
Ingersoll-Sergeant Rock Drill Co.
Morris County Machine & Iron Co.
Norwalk Iron Works Co.
Penn Diamond Drill & Mfg. Co.
Rand Drill Co. (See Diamond Drills.)
Aluminum
Cowles Electric, S. & A., Co.
Amalgamators
Bucyrus Steam Shovel & Dredge Co.
Gates Iron Works.
Architects and Builders
Berlin Iron Bridge Co.
Pencoyd Bridge & Const. Co
Pennsylvania Steel Co.
Pollock, Wm. B. & Co.
Scaife, Wm. B. & Son.
Arms and Ammunition
Hartley & Graham.
Asbestos
Leofred A.
Assayers' and Chemists' Supplies
Ainsworth, Wm.
Baker & Adamson.
Baker & Co.
Berge, J. & H.
Bullock & Crenshaw.
Denver Fire Clay Co.
Greiner, Emil.
Henry Heil Chem. Co.
Hoskins, Wm.
Overbrook Chem. Co.
Penn Sm. & Ref. Wks.
Penna. Salt Mfg. Co.
Queen & Co.
Richards & Co.
Roessler & Hasslacher Chemical Co.
Sargent, A. H., & Co.
Snelson, W. H., Assay. & Engineering Co.
Socorro Fire Clay Co.
Solvay Process Co.
Taylor, John, & Co.
Troemner, Henry.
Voland & Van Zelm.
Bankers and Brokers
Bandell, E. H.
Bieber & Sohne.
Billings, Robt. & Co.
Chisolm, A. R., & Co.
Cochran, A. M.
Gelder, Bailey & Co.
Grant, E. R.
Handy & Harman.
Hyde, Geo. A.
Nevin Commission Co.
Peabody & Kolff.
Pullman, J. W.
Smith, C. H.
Trenholm, Paul C.
Von Rosenberg, Leo.
Belting
Hendrie & Bolthoff Mfg. Co.
Jeffery Mfg. Co.
Link Belt Machinery Co.
New York Belting & Packing Co., Ltd.
Blasting Caps and Fuse
Lau, J. H., & Co.
Macbeth, James, & Co.
Metallic Cap Mfg. Co.
Blowers
Sturtevant, B. F. Co.
Boiler Compound
American Fluoride Co.
Boilers
Babcock & Wilcox Co.
Buckeye Engine Co.
Heine Safety Boiler Co.
Lidgerwood Mfg. Co.
Orr & Sembower, Inc.
Pollock, Wm. B., & Co.
Scaife, Wm. B. & Sons.
Star Boiler & Sheet Iron Works.
Stirling Co.
(See Machinery.)
Brake Shoes
Sargent Co.
Brick Machinery
Freese, S. M., & Co.
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Berlin Bridge Co.
Pencoyd Br. Con. Co.
Penna. Steel Co.
Scaife, W. B., & Sons.
Buckets
Clark, W. J., & Co.
Scaife, Wm. B. & Sons.
(See Machinery.)
Calculators
Smith, R. C.
Carbons
Bishop, Victor, & Co.
Car Wheels
Whitney A. & Co.
Chain and Link Belting (See Belting.)
Chemicals
Baker & Adamson.
Bullock & Crenshaw.
Henry Heil Chem. Co.
Overbrook Chem. Co.
Penn. Salt Mfg. Co.
Roessler & Hasslacher Chemical Co.
Solvay Process Co.
Vandenbergh Lab'tory
Coal
Barwind-White Coal Mg. Co.
Castner & Curran
Consolidation Coal Co.
Coxe Bros. & Co.
Haddock, Shonk & Co.
Maryland Coal Co.
Meeker & Co.
Potts, F. A., & Co.
Stickney, Conyngham & Co.
Ward & Olyphant.
Coal Cutters
Ingersoll-Sergeant Drill Co.
Jeffrey Mfg. Co. (See Machinery.)
Coke
Rainey, W. J.
Concentrators, Crushers, Pulverizers, Separators, Etc.
Allis, Ed. P., & Co.
American Ore Machinery Co.
Beckett Foundry & Machine Co.
Blake, Theo. A.
Bradley Fertiliser Co.
Colorado Iron Works.
Copeland & Bacon.
Dimon & Adams.
Fraser & Chalmers.
Frisbee-Laucop Mill Co.
Frue Vanner Concentrator.
Gates Iron Works.
Hendrie & Boltnoff Mfg. Co.,
Krom, S. R.
Mechanical Gold Extractor Co.
Pierce & Miller Engineering Co.
Risdon Iron Works.
Sturtevant Mill Co.
Totten & Hogg Foundry Co.
Walburn-Swenson Mfg. Co.
(see Machinery.)
Copper Dealers and Producers
Abbott, Jere., & Co.
American Metal Co.
Atlantic Mining Co.
Balbach S. & Ref. Co.
Baltimore Cop. W'ks.
Boston & Col. S. Co.
Boston & Mont. M.Co.
Central Mining Co.
Copper Queen Mg.Co.
Chicago Cop. Ref'g Co.
Detroit Copper Mg. Co.
Lewisohn Bros.
Orford Copper Co.
Osceola Con. Mg. Co.
Penn. Salt Co.
Phelps, Dodge & Co.
Quebrada R. R., L. & C. Co.
Tamarack Mg. Co.
Contractors' and Miners' Supplies
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Carpenter, Geo. B., & Co.
Lidgerwood Mfg. Co.
Pollock, Wm. B., & Co.
Pratt & Whitney Co. (See Machinery.)
Corrugated Iron
Berlin Iron Bridge Co. | Scaife, W. B., & Sons.
Couplings
Lake Co., J. H. & D.
Desks, Chairs, Etc.
Andrews, A. H. & Co.
Diamonds
Bishop, Victor, & Co.
Diamond Drills
American Diamond Rock Boring Co.
Bishop, Victor, & Co.
Bullock Mfg. Co., M. C.
Hasenzahl, W.
Locke & Hazenzahl.
Penn. Diamond Drill & Mfg. Co.
Sullivan Machinery Co.
(See Air Compressors and Rock Drills.)
Drawing Materials
Altenedер, Theo. & Son.
Heller, Chas. S.
Keuffel & Esser Co.
Schwenke, Kirk & Co.
Dredges
Bucyrus Steam Shovel & Dredge Co.
Figee Bros.
Souther & Co.
Dump Cars
Hunt Co., C. W.
Thacher Car & Con. Co.
Dynamos
National Electric Mfg. Co.
Educational Institutions
Corcoran Scientific School.
Harvard Univ. (Lawrence Scientific School)
Michigan Mining School.
Pennsylvania Military College.
State School of Mines.
University of Arizona.
Vanderbilt University.
Woodside Seminary.
Electrical Machinery and Supplies
General Electric Co.
Jeffrey Mfg. Co.
National Electric Mfg. Co.
Okonite Co., Limited.
Thomson-Houston International Co.
Elevators, Conveyors and Hoisting Machines
Brown Hoisting and Convey. Mach. Co
Clark, W. J., & Co.
California Wire Works.
Cooper, Hewitt & Co.
Davis, F. M., Iron Works.
Hunt, C. W., Co.
Jeffrey Manufacturing Co.
Lidgerwood Mfg. Co.
Link-Belt Machinery Co.
Orr & Sembower, Inc.
Scaife, Wm. B. & Sons.
Union Wire Rope Tramway Co.
Vulcan Iron Wks.
(See Wire Rope Tramway and Machinery.)
Emery Wheels
New York Belting & Packing Co., Ltd.
Emery Mill Stones
Sturtevant Mill Co.
Employment Bureaus
Engineering Employment Bureau.
Enterprise Employment Agency.
Engineers, Chemists, Metallurgists
Adams, J. N.
Adams, W. H.
Argall, Philip.
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Iron & Coal Trades Review.
Indian Engineering.
Weekly Bulletin.
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